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NUCLEAR SCIENCE ABSTRACTS

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NOTICE

A title page for Volume 19, Numbers 1–6, is included at the back of this issue for use in binding the first quarter of this volume.

CORRECTIONS

NSA Vol. 18, No. 13, pg. 3015. Abstract 22274, the report number now reads: N64-13168, Should read: N64-13186.

NSA Vol. 18, No. 24, pg. 5833. Abstract 43342, in Descriptive Cataloging, Minerva Med. .... Should read: Accad. Med., Genova, 76: 94-112(Jan.-June 1961).

NSA Vol. 18, No. 24, pg. 5833. Abstract 43343, in Descriptive Cataloging, Minerva Med. .... Should read: Accad. Med., Genova, 76: 147-53(July-Dec. 1961).

NSA Vol. 18, No. 24, pg. 5950. Abstract 44153, in line 6 of the abstract, ^{182}Nb ...... Should read: ^{182}Ta ......

Volume 19, Number 6, March 31, 1965

NUCLEAR SCIENCE ABSTRACTS

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Volume 19, Number 6 March 31, 1965

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

Refer also to abstract 9157.

8720 (CEA-R-2524) LES RECHERCHES FRANCAISES EN AGRONOMIE NUCLEAIRE. (French Research in the Field of Nuclear Agronomy). Pierre Guerin de Montgareuil (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Cadarache). July 1964. 12p. Dep.(mn).

Work in the field of nuclear agronomy carried out in France since 1958 is reviewed. Topics discussed include applications of radiation in studies of plant genetics, pest eradication, food processing, measurements of soil humidity and density, and the use of radioisotopes as tracers in studies of plant physiology, agronomy, pathology, agricultural entomology, and metabolism in domestic animals. (C.H.)

8721 (EUR-1884.e) EURATOM'S BIOLOGY PROGRAMME, 1961–1964 REPORT AND PERSPECTIVES. R. K. Appleyard (European Atomic Energy Community). 1964. 37p. Dep.(mn).

The organization and scope of the biological research program of the European Atomic Energy Community from 1961 through June 1964 are reviewed. Emphasis was placed on studies on the genetic effects of radiation, the use of radioisotopes as tracers for metabolic studies, the movement of fallout fission products through the environment into the food chain of man, radiation dosimetry, the use of radioinduced mutations to improve agricultural plants, the radiation processing of food, and training programs in the field of radiobiology. A list is included of research contracts and programs during the period covered by this report. (C.H.)

8722 (ISS-64/32) LA FISICA AL SERVIZIO DELLA MEDICINA. (The Importance of Physical Concepts to Medicine). M. Ageno (Italy. Istituto Superiore di Sanita, Rome). Sept. 2, 1964. 26p. Dep.(mn).

The contributions of physics to the theory of medicine is discussed. Uses of ionizing radiation in studies of structure and functions are discussed briefly. (C.H.)

8723 (LF-19) FLORA OF HEALTHY DOGS. III. INCIDENCE AND DISTRIBUTION OF SPIROCHETES IN THE DIGESTIVE TRACT OF DOGS. Technical Progress Reports. F. F. Pindak, W. E. Clapper, and J. H. Sherrod (Lovelace Foundation for Medical Foundation for Medical Education and Research, Albuquerque, N. Mex.). Nov. 1964. Contract AT(29-2)-1013. 36p. Dep.; $0.75(OTS).

Results are reported from a study of the incidence, distribution, and pathogenicity of spirochetic bacteria in a colony of healthy dogs. The spirochetes found in the feces of dogs were divided into three categories based on morphology. These were: borrelias, treponemes, and fairly large double-contoured organisms. Some variation was observed within each group. Classification or further subdivision was not attempted because definitive characteristics necessary for such a purpose were not available. The live organisms could be readily demonstrated when a wet preparation was viewed in phase contrast illumination under 400 X magnification. When present in small to moderate numbers the spirochetes were considered as part of the normal intestinal flora but large numbers caused intestinal bleeding. Orally administered Furadantin, sulfaguanidine, or penicillin, in the dosages used, had no effect on the spirochetal population of the rectum. Terramycin caused a temporary elimination of all three types of organisms, but their recurrence was seen four to five days after termination of treatment. Dogs given a combination of the four chemotherapeutic agents were freed of all spirochetes for at least 41 days after the treatment, but became reinfected during two to thirteen days of association with spirochete-carrying dogs. Penicillin, sulfaguanidine, or Furadantin might therefore be administered orally to suppress other bacterial flora and thus facilitate the isolatión and cultivation of the spirochetes. (C.H.)

8724 (NLCO-933) RECENT BIO-ASSAY ACTIVITIES AT NATIONAL LEAD COMPANY OF OHIO. Michael W. Boback and Richard C. Heatherton (National Lead Co. of Ohio, Cincinnati). Sept. 28, 1964. Contract AT(30-1)-1156. 17p. (CONF-727-4). Dep.(mn); $1.00(cy), 1(mn) OTS.

From 10th Annual Bioassay and Analytical Chemistry Meeting, Cincinnati, Oct. 1964.

Some recent non-routine problems which have occupied the interest of the Bio-Assay Department, Health & Safety Division, National Lead Company of Ohio are discussed. These include the use of infrared and induction heating for the fusion step in the fluorometric determination of uranium; uranium in lung and lymph node tissues from unexposed persons; passivity of uranium slivers in hand injuries; radium isotopes found in residue from uranium remelt operations; investigations of the increase in plant radiation levels; uranium in fecal samples; and radionuclides in a plant effluent which results from precipitation run-off. (auth)

8725 (NP-14448) QUARTERLY PROGRESS REPORT NO. 53 [ON RADIOBIOLOGY]. (Chicago. Univ. Air Force Radiation Lab.). Oct. 15, 1964. Contract AF41(609)-1693. 142p. (AD-607952). $4.00(OTS).

Separate abstracts were prepared on nine sections of this report covering the testing and toxicity of various radioprotective compounds. (C.H.)

For abstracts of individual papers see: 8741, 8742, 8787, 8788, 8789, 8790, 8953, 8954, and 8955.

8726 (NP-14556) REPORT OF THE UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION. General Assembly, Official Records: Nineteenth Session. Supplement No. 14 (A/5814). (United Nations. Scientific Committee on the Effects of Atomic Radiation). 1964. 124p.

Separate abstracts were prepared on three sections of this report covering fallout data, results of investigations of radioinduced neoplasms in man, and report references. (C.H.)

For abstracts of individual sections see: 8791, 8792, and 9370.

8727 (TID-20373) THE EFFECT OF TRIS ON MOUSE LIVER TISSUE AND SUBFRACTIONS. G. Lew Choules (Johns Hopkins Univ., Baltimore. McCollum-Pratt Inst.). [Jan. 15, 1964]. Contract AT(30-1)-1822. 13p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Tris (hydroxymethyl) aminomethane (TRIS) is widely used as a buffer in the preparation of animal and plant tissues and extracts for microscopic examination. Procedures are described for the preparation of mouse liver tissues and subfractions for electron microscopy using an isolation media containing TRIS. (C.H.)

8728 STUDIES OF INDUCED MUTATIONS IN PEAS. IX. INDUCTION OF LEAF SPOTS IN PEAS. S. Blixt (Plant Breeding Inst., Weibullsholm, Sweden). O. Gelin, R. Mossberg, G. Ahnstrom, L. Ehrenberg, and R. A. Lofgren. Agr. Hort. Genet., 22: 186-94(1964).

The occurrence of leaf spots in peas after treatment with ethyl methane sulfonate (EMS) was studied, and the results compared with those obtained with ethyleneimine and γ rays. It was found that within a single plant the number of spots decrease from the oldest (first) leaf to the youngest (fourth) leaf. Leaf spotting increased with increasing concentration of EMS. An effect was found also at very low concentrations where no effect on growth reduction had been discernible, indicating that leaf spotting may be at least about 100 times more sensitive than growth reduction for measuring the effects of treatment. The fact that EMS, which does not cause chromosomal aberrations under the conditions used, is highly effective in producing leaf spots indicates that a gene mutational mechanism may be active. (BBB)

8729 GENE CONTROL OF PIGMENTATION ASSOCIATED WITH SPECIFIC LYSINE REQUIREMENT OF *SACCHAROMYCES*. Jnanendra K. Bhattacharjee and Gertrude Lindegren (Southern Illinois Univ., Carbondale). Biochem. Biophys. Res. Commun., 17: 554-8(Nov. 30, 1964).

Genetic and biochemical studies were made on pigment-production associated with a loci (ly_9) auxotroph produced by a radio-induced mutant in Saccharomyces. The lysine-requiring yellow strain (B3003, ly_9) was plated on glucose nutrient agar for single cell isolation and subsequently replicated on complete synthetic agar without lysine and on glucose nutrient agar (control). After 48 hr incubation at 30°C, a mixture of white and yellow colonies (87 : 70) appeared on the control plate, while no colonies appeared on the lysine-deficient synthetic agar, indicating that the white colonies were not revertants of the lysine auxotroph, but rather back mutations to the wild type phenotype of pigmentation due to an event having no impairment on lysine. A hybrid (B2923α, ur, yel, ly x B3003-1 a, ad, YEL, ly) was made between the white and a yellow strain, both of which were lysine-requiring. Analysis of 28 tetrads from this hybrid revealed a 2 : 2 segregation of yellow and white, thus demonstrating that the pigment phenotype (yellow) is gene controlled. (P.C.H.)

8730 INVESTIGATION OF AN OPERATOR METHOD IN THE ANALYSIS OF BIOLOGICAL TRACER DATA. J. Myhill, G. P. Wadsworth, and G. L. Brownell (Massachusetts Inst. of Tech., Cambridge). Biophys. J., 5: 89-107 (Jan. 1965).

Some factors affecting the usefulness of a linear operator in the analysis of tracer data were evaluated. Application of the operator to a sum of two exponential components resulted in the separation of the rate constants with an accuracy of 10 to 15% if they differed by a factor of at least 2 and the error in the data was about 2%. A factor of 4 was necessary if the error in the data was 6%, and of 6 if the error was 10%. The ratio of amplitudes varied from near unity to equality with the ratio of rate constants. However, if the ratio of amplitudes was greater than the ratio of rate constants the method would not resolve the rate constants. Application of the operator to a sum of three exponential components was also considered. (auth)

8731 RADIOACTIVE ISOTOPES. ATOMIC ENERGY BONUS. Paul C. Aebersold (Atomic Energy Commission, Washington, D. C.). Chemistry, 35: 1-25(Jan. 1962).

Applications of radioisotopes in medicine, industry, agriculture, and space exploration are reviewed. (BBB)

8732 POLISH MEDICAL JOURNAL, VOLUME III, NUMBER 2, 1964. Translation of Patol. Polska, 14: 235-488(1963). 254p. OTS-64-11409/2. $2.50(OTS).

A separate abstract was prepared for one article in this journal. Other articles discuss a variety of clinical and metabolic studies. (C.H.)

For an abstract of the individual paper see: 8892.

8733 PROCEEDINGS OF THE IX CONGRESS OF THE INTERNATIONAL SOCIETY OF HEMATOLOGY, [UNIVERSITY OF MEXICO, MEXICO CITY, SEPT. 17-23, 1962]. [VOLUME I]. Proc. Intern. Congr. Hematol., 9th, Mexico City, 1962, 1: 1-751(1964). Mexico City, Universidad Nacional Autonoma de Mexico, 1964. (CONF-620901(Vol.1))

Separate abstracts were prepared for two articles contained in this volume. Other articles discuss erythrocytes and erythropathies, leukocytes and leukopathies, and thrombocytes and thrombopathies. (C.H.)

For abstracts of individual papers see: 8896 and 8897.

8734 ISOTOPE DISSECTION. J.-J. Bernier (Hopital Saint-Lazare, Paris). Rev. Praticien, 14: 3483-94(Nov. 1, 1964). (In French)

The method of isotopic dissection used for measurement of extracellular liquid, protein-containing tissues, and fats in living organisms is described. The critiques of this method for determination of total water are given. The calculations made from measurement of the exchangeable potassium and chlorine or exchangeable sodium are discussed. The advantages and disadvantages are indicated. Some practical applications of the method to clinical studies of cirrhosis and obesity are given. (J.S.R.)

Ecology

8735 CYCLING OF CESIUM-134 IN WHITE OAK TREES. John P. Witherspoon (Oak Ridge National Lab., Tenn.). Ecol. Monographs, 34: 403-20(1964).

Cesium-134 inoculated into white oak (*Quercus alba* L.) was used to study the distribution patterns of an element in a forest ecosystem, special attention being given to site factors influencing distribution. The cycle of ^{134}Cs in white oak trees was followed from spring, 1960, to autumn, 1961. Three trees on each of four sites differing in soil type and moisture were each inoculated with 2.0 mc ^{134}Cs. Redistribution of this radioisotope during the growing season was estimated by sampling from inoculated trees, understory, litter, and soil. Chemical and physical properties of soils (Fullerton and Landisburg on dolomitic dry and wet sites, respectively; and Sequoia and Monongahela on shale dry and wet sites, respectively) were determined. With rapid translocation into leaves from initial trunk inoculations in the spring, white oak leaves contained 10^5 to 10^6 dpm ^{134}Cs per g dry weight by early June. This represented a total transfer of about 40% of the original input. With the first rains following inoculation, loss of radiocesium from leaves began. These losses continued throughout the growing season until September, by which time total loss of 15% of the observed maximum concentration in leaves had occurred. Of this rain-induced loss, 70% reached the mineral soil by September, the remainder being located in litter and understory vegetation. Radiocesium transferred from trees via annual leaf fall was approximately two times greater than the quantity exported by rain. With subsequent leaching over the winter months, the litter produced by inoculated trees lost about half of its radiocesium to the mineral soil. Passage of this element through trees, litter, and roots was found to be very rapid. Transfers from litter to vegetation were demonstrated as well as transfers by leaching from living leaves to understory vegetation. Downward movement of radiocesium in soils under tagged trees was observed, and soils on wet sites had significantly greater percentages at lower depths down to 12 in. (30 cm). However, 92% of the total soil radiocesium remained in the top 4 in. (10 cm) 1 year and 7 months after tree inoculation. A definite pattern of distribution, presumably related to leaching and stem flow, was found under tagged trees, with 19% of the soil radiocesium occurring near the trunk and 80% confined to the area underneath the crown. Total annual loss of this radioisotope from inoculated trees was estimated at 19% of the original inoculation. Results from analysis of four trees harvested at the end of the study indicated that estimates of radiocesium remaining in trees one year and seven months post inoculation were 13.3 ± 3.0% high. (H.M.G.)

8736 TRITIATED WATER AS A TOOL FOR ECOLOGICAL FIELD STUDIES. Frank W. Woods and Denny O'Neal (Duke Univ., Durham, N. C.). Science, 147: 148-9(Jan. 8, 1965).

Tritium was used to investigate the withdrawal by small trees of water from soil at three depths. Within 4 hours of placement at each depth, tritium was detected in the transpired water from nearby trees. On the 3rd day after application, 38 times more tritium (per unit volume) was present in transpired water drawn from soil at a depth of 0 to 30.5 centimeters than in water drawn from the 61- to 91.5-centimeter level. (auth)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstracts 9078 and 9372.

8737 (BNL-8657) CESIUM-137 AND STRONTIUM-90 RETENTION FOLLOWING AN ACUTE INGESTION OF RONGELAP FOOD. Edward P. Hardy, Jr., Joseph Rivera (New York Operations Office. Health and Safety Lab., AEC); and Robert A. Conard (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT-30-2-GEN-16. 24p. (CONF-765-7) Dep.(mn); $1.00(cy), 1(mn) OTS.

From 2nd Conference on Radioactive Fallout from Nuclear Weapons Tests, Germantown, Md., Nov. 1964.

Marine and plant foods used by natives living on Rongelap in the Marshall Islands contain higher levels of long-lived fission product radionuclides than diets of people living in the United States due to residual contamination from a fallout accident in 1954. During the 1963 medical survey of the Rongelap population, three food items indigenous to the Rongelapese diet were brought back to the United States and consumed over a seven day period by one member of the medical team. The ingestion of these foods introduced levels of strontium-90 and cesium-137 which were 20 and 60 times higher, respectively, than the normal diet, and was therefore considered in terms of an acute intake of two fission product radionuclides, important from a radiological standpoint. Urinary and fecal collections were analyzed separately and whole-body cesium-137 measurements were made using a whole-body counter. The urine was the principal excretory route for the cesium-137 while the main removal pathway for the strontium-90 was the feces. The retention of strontium-90 could be represented by a series of exponentials while the retention of cesium as determined by whole-body counting indicated a single compartment removal process with a biological half-life of 74 days. Reasonably good agreement was obtained between retention as determined by whole-body counting and by excretion measurements. It is estimated that about 25 percent of the strontium-90 from the Rongelap food was retained by the body at the end of 190 days. The average urinary to fecal excretion ratio for cesium-137 was 3.5 while the ratio for strontium-90 was 0.06. These findings are in agreement with other studies during which strontium-90 and cesium-137 were ingested under a variety of experimental and accidental conditions. (auth)

8738 (EUR-1825.i) STUDIO DELLA BIOLOGIA DEI PESCI DEL LAGO MAGGIORE, ALLO SCOPO DI RACCOGLIERE QUELLE INFORMAZIONI CHE PERMETTANO DI PREVEDERE LE EVENTUALI INTERAZIONI TRA QUESTI ANIMALI E LA RADIOATTIVITA' PRESENTE NELLE ACQUE DEL LAGO (ANNO 1962). (Study on the Biology of Fish in Lake Maggiore With the Aim of Collecting Data as a Basis for Forecasting Possible Interactions Between these Fish and the Radioactivity Present in the Lake Water (Year 1962)). (Italy. Istituto Italiano di Idrobiologia, Pallanza). 1964. 12p. Dep.(mn).

Results are reported from a study of perch (Perca fluviatilis) and whitefish (Coregonus sp.) found in Lake Maggiore, Italy. Data are presented on morphological characteristics, dietary habits, and growth rates of the fish. (C.H.)

8739 (HW-SA-3746) MILK SECRETION OF ZINC AND CADMIUM IN THE RUMINANT. B. J. McClanahan, R. O. McClellan, J. R. McKenney, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 6, 1964. Contract AT(45-1)-1350. 15p. (CONF-641105-1). Dep.(mn); $1.00(cy), 1(mn) OTS.

From Symposium on the Use of Radioisotopes in Animal Nutrition and Physiology, Prague.

Zinc-65 concentrations were determined in the milk and plasma of two ewes following daily oral administration. The ^{65}Zn concentration in the colostrum was 20 to 30 times that in plasma, and decreased to a value of about 10 times that in plasma in early milk. A constant fraction of the intravenously administered dose of ^{65}Zn and ^{115m}Cd was transferred from plasma to milk in spite of a progressive reduction in the plasma clearance of each radioisotope when the amount of administered zinc was increased, resulting in decreasing milk to plasma ratios. When the milk secretion rate was reduced, ^{65}Zn and ^{115m}Cd were reversibly transferred between plasma and milk. This transfer was not affected by the amount of zinc introduced simultaneously. (auth)

8740 (IAEA-R-37-5) PROGRESS REPORT CONCERNING INTERNATIONAL ATOMIC ENERGY AGENCY RESEARCH CONTRACT NO. 37, MAY 1962–DECEMBER 1962. Karen Garder (Norway. Institutt for Atomenergi, Kjeller); Magne Grande, and Olav Skulberg (Norsk Institutt for Vannforskning, Blindern). Contract No. 37. Dep.(mn)

Results are summarized from ecological studies conducted during the summer of 1962 on the flora and fauna of the Nitelv River area of Norway near the Skedsmo Weather Station. Measurements were made of the radioactivity in aquatic plants and animals due to fallout and natural background radioactivity. Plant and animal communities were established in river water field stations and the metabolism of ^{32}P, ^{137}Cs, ^{89}Sr, ^{144}Ce, ^{95}Zr, ^{95}Nb, and ^{103}Ru by algae, fish, and invertebrates was studied after the addition of these radioisotopes. The sorption of the radioisotopes on river sediments was also measured and additional metabolic studies on fish were carried out in aquaria simulating natural environmental conditions. Data on climatic conditions during the period are included. (C.H.)

8741 (NP-14448(p.98-107)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. III. STUDIES ON THE TOXICITY AND MECHANISM OF ACTION OF MERCAPTOETHYLAMINE (MEA). Kei-Ming Yam, Bernard E. Hietbrink, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

Experiments were conducted using various types of chemical agents to reduce the acute toxicity of mercaptoethylamine (MEA) in rats. Diphenylhantoin and antihistamines (diphenhydramine and pyribenzamine) are ineffective in reducing the toxicity of MEA. Reserpine is promising when given at the appropriate time before MEA. Studies on the acute toxicity of MEA in guinea pigs did not indicate that this species is more susceptible to MEA than rats. This information along with the absence of antidotal effects by antihistamine drugs provide evidence that histamine is not responsible for the gross acute toxic action of MEA. Studies on the influence of pentobarbital pretreatment on the radioprotective action of MEA revealed that pentobarbital does not reduce the radioprotective action of moderate doses of MEA (200 and 300 mgm./kgm.) but when 500 mgm./kgm. of MEA was given with pentobarbital very little radioprotective activity was obtained. The results of studies on a combination of pentobarbital plus cysteine or pentobarbital plus glutathione revealed that they are ineffective in reducing the toxicity of MEA. Pentobarbital was only slightly effective in reducing the acute toxicity of AET. Acute toxicity studies on MEA and AET in weanling male rats revealed that the young animals are somewhat more resistant than adult females to these chemical agents. (auth)

8742 (NP-14448(p.132-9)) THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. II. HISTOLOGICAL FINDINGS IN THE TISSUES OF MICE SERIALLY SACRIFICED AFTER FEEDING A DIET CONTAINING PARA-AMINOPROPIOPHENONE. D. Vesselinovitch, A. Sandberg, and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

Gross and microscopic examinations were made of the hematopoietic tissues on CF_1 female mice fed a diet containing 0.1% *p*-aminopropiophenone (PAPP). Moderate to pronounced erythroblastic hyperplasia in the spleen was observed in all mice sacrificed from the third day through the seventh day and in a few animals sacrificed on the second day. Hypercellularity (mild to moderate) of the bone marrow was seen in most of the mice killed from 4 days on and in one mouse sacrificed on the second and one on the third day of PAPP feeding. Hypercellularity of the lymphoid tissue in the thymus and mesenteric lymph node was observed in all animals sacrificed from the fourth day on. This finding varied in degree from mild to moderate. Mild to moderate atrophy of lymphoid tissue was present in PAPP-fed animals sacrificed from the second through seventh day. The severity of atrophy paralleled the degree of erythroblastic hyperplasia. (auth)

8743 (JPRS-26888) DISTRIBUTION OF RADIOACTIVE CALCIUM AND ITS EXCRETION FROM THE BODIES OF HEALTHY AND LEAD-POISONED ANIMALS. K. K. Makashev and L. V. Kazachenko. Translated from Izv. Akad. Nauk Kaz. SSR, Ser. Med. Nauk, No. 1, 50-5(1964). 7p. (TT-64-51145). $1.00(OTS)

Rats were poisoned with 2.5% lead acetate administered in drinking water for 4 or 5 mo. and the effects of Ca on metabolism were studied using ^{45}Ca as a tracer. The poisoned animals excreted less ^{45}Ca than the animals of the control group. The lower ^{45}Ca elimination in the poisoned animals was attributable to the feces; the same quantity of calcium was excreted in the urine in the normal and poisoned animals. The rate at which ^{45}Ca accumulated in the bone tissue was considerably higher in the poisoned animals. (C.H.)

8744 PHOSPHORUS-32 INCORPORATION IN LIPID PHOSPHATE AND NUCLEIC ACIDS OF THE LIVER OF NORMAL AND CCl_4-INJURED MICE. G. Richter and M. Neumann (Universitat, Jena, Ger.). Acta Biol. Med. Ger., 11: 786-98(1963). (In German)

During the first few minutes after a CCl_4 injury in the liver of mice about one-third of all ribosomes becomes detached from the ergastoplasm lamellae. Studies using ^{32}P as a tracer showed that the RNA of the detached ribosomes does not participate in the turnover. During the first hours after the injury the turnover of the phospholipids is considerably reduced. (BBB)

8745 ACCRETION OF ^{131}I AND TRIIODOTHYRONINE ^{131}I BY THE RAT OVARY. M. B. Yatvin and J. H. Leathem (State Univ., New Brunswick, N. J.). Acta Endocrinol., 47: 144-8(Sept. 1964).

Ovarian accretion of ^{131}I and triiodothyronine (T_3) were utilized to investigate ovarian activity as influenced by hypothyroidism, gonadotropin treatment, and the combination of hypothyroidism and gonadotropin treatment. Human chorionic gonadotropic administered daily for 5 days enhanced the ovarian uptake of the ^{131}I in euthyroid and hypothyroid rats to the same degree. Thiouracil-feeding alone did not affect the accretion of ^{131}I by ovaries. When injections of human chorionic gonadotropin (HCG) were continued for 20 days, the ovarian affinity for ^{131}I was reduced in euthyroid and hypothyroid rats. Furthermore, less ^{131}I was fixed by the ovary of normal rats when the experimental period was extended from 15 to 30 days. Thiouracil prevented the reduction in uptake of ^{131}I by the ovary. Accumulation of T_3-^{131}I by the ovary was not influenced by feeding thiouracil for 15 days or by HCG administrations for 5 days. Extending the period to 30 days resulted in a lower uptake of T_3 by the ovary from normal rats. A greater uptake was observed in animals treated with HCG or fed thiouracil but in each case the T_3 uptake was less than that observed in the younger rat. (TCO)

8746 USE OF ISOLATED SUBCUTANEOUS INTESTINAL LOOPS FOR DIRECT STUDY OF INTESTINAL ABSORPTION OF RADIOISOTOPES IN DOGS. M. John Murray, John P. Delaney, and Nell Stein (Univ. of Minnesota, Minneapolis). Am. J. Digest. Diseases, 9: 684-9(Oct. 1964).

A direct counting method was developed for following the disappearance rate of radioactivity of a γ-emitting isotope placed in an intestinal loop located in the subcutaneous tissue. This provided a good measure of the absorption of that isotope. The problem encountered in the preparation of these loops and their use in absorption studies were investigated. An isolated segment of gut was placed close to the surface of the skin, making it possible to observe the rate of disappearance of radioisotopes from the segment and thus determine the rate of absorption. This technic obviates the dependence upon blood levels of the substance, which are based on measurements of absorption from the gut and disappearance from the plasma into tissue. It also makes possible the study of the effect of local or humoral variables on the absorption of the radioelement in question. Loops of gut from different intestinal levels were constructed and placed in the subcutaneous tissues of the abdominal wall of dogs. The stoma of the loop opened onto the skin surface. Iron-59 and ^{57}Co were placed in the loops and the disappearance rate determined with a collimated crystal scintillation detector and rate meter. The results from runs using loops from different levels of the gastrointestinal tract show that the shapes of the radioisotope disappearance curves from any one level are very similar in the same dog and are readily reproducible. They do, however, vary from dog to dog, and for comparative studies the same dog should be used. Furthermore, the shape of the disappearance curve agrees with the shape of the plasma appearance curve. Background activity from accumulation of the isotopes in neighboring tissues did not significantly affect the results, and shielding around the stoma was not necessary. However, the stoma and loop were constructed in a location well away from the liver, to avoid confusion with counts from the liver. A significant absorption of ^{59}Fe was shown to take place from the colon. (BBB)

8747 REGULATION OF Ca^{45} TRANSFER IN RAT SALIVARY AND LACRIMAL GLANDS *IN VITRO*. Robert H. Dreisbach (Stanford Univ., Palo Alto, Calif.). Am. J. Physiol., 207: 1015-20(Nov. 1964).

The transfer *in vitro* of ^{45}Ca either into or out of rat salivary and lacrimal glands is stimulated by sympathetic and parasympathetic agents. The transfer of ^{85}Sr in both directions is also similarly stimulated by acetylcholine. The stimulation of ^{45}Ca transfer in both directions by acetylcholine is inhibited by Na lack and by metabolic inhibitors such as azide, dinitrophenol, cyanide, mercuric ion, fluoride in absence of Ca and Mg, lack of oxygen, iodoacetate, and low temperatures. The acetylcholine effect on inward transfer is also reduced or inhibited by increased Ca or Sr, or by EDTA, but is apparently not affected by altered concentrations of K or Mg. In contrast, the acetylcholine effect on outward transfer is not affected by altered Ca concentration or addition of EDTA. Exogenous substrate is not necessary for stimulation of movement in either direction. (auth)

8748 CALCIUM CONTENT AND CALCIUM-45 TURNOVER IN SMOOTH MUSCLE UNDER THE INFLUENCE OF PAPAVERINE, PILOCARPINE, AND 2,4-DINITROPHENOL. K. H. Rahn (Universität, Mainz). Arch Exptl. Pathol. Pharmakol., 247: 322(1964). (In German)

The effects of certain drugs on the uptake and release of ^{45}Ca were studied in vitro with guinea pig intestinal smooth muscle. Exchange of ^{45}Ca was investigated under different experimental conditions, and the total Ca content was also determined. None of the three compounds altered total Ca content of the muscle. Papaverine markedly changed the ^{45}Ca uptake ($t_{1/2}$ decreasing from 2.5 min in control specimens to 1.0 min) and release ($t_{1/2}$ decreasing from 4.5 to 3.0 min). The pilocarpine-treated preparation did not differ from controls in the exchange of ^{45}Ca, and dinitrophenol did not affect ^{45}Ca uptake. The increased motility of intestinal muscle by pilocarpine did not account for its acceleration of ^{45}Ca exchange, since papaverine has a similar effect on motility without influencing ^{45}Ca influx or efflux. The muscle-relaxing action of dinitrophenol also has no effect on ^{45}Ca exchange or Ca content. (BBB)

8749 VITAMIN A-INDUCED INTENSIFICATION OF RESORPTION PROCESSES IN THE BONE TISSUE AND ITS EFFECT ON THE RADIOACTIVE-CERIUM INCORPORATION. T. Trnovec, M. Beno, V. Zboril, V. Rusek, A. Pleskova, and P. Kluvanek. Bratislav. Lekarske Listy, 53-I: 529-35(May 1963).

It was determined in 7 rats that administration of vitamin A led to an intensification of bone resorption. After intravenous injection of ^{141}Ce, the concentration of radioactive cerium in various organs and femur diaphysis was measured. Radioactive cerium was found in significantly higher concentrations in the diaphyses of 6 control rats who had received no vitamin A; therefore it was not possible to confirm the supposed relationship between the resorption process and the incorporation of rare earth radioisotopes. (Occupational Safety Health Abstr., 2: No. 6, 1964)

8750 EFFECT OF ADRENAL CORTICAL HORMONES ON I^{131} ABSORPTION BY THE THYROID AND ON THE RESPIRATION OF ITS PARENCHYMA. V. V. Natarov (Khar'kov Medical Inst., SSSR). Bull. Exptl. Biol. Med. (USSR) (English Transl.), 57: 187-90(Feb. 1964). Translated from Byul. Eksperim. Biol. i Med., 57: 68-72 (Feb. 1964).

The influence of cortisone-acetate and desoxycorticosterone acetate (DOCA) on absorption and excretion of ^{131}I by the thyroid gland depends on the dose and the length of action of the hormonal preparations. The action of DOCA (1.5 mg per 100 gm of body weight) and of cortisone (1.5 mg per 100 gm of body weight) varies; this is manifested in different periods of appearance of the maximal iron radioactivity (in experiments with DOCA–3 days, with cortisone–5), its value (in DOCA more than in cortisone), and in the nature of action (on the 3rd day DOCA increases, and cortisone reduces the isotope absorption as compared to control). In experiments in vitro carried out in a Warburg apparatus cortisone-acetate and DOCA changed the respiration of the thyroid gland tissue. A rise in the cortisone dose (0.4–1.0–4.7 mg) caused a parallel rise in the oxygen intake by the thyroid gland, whereas DOCA intensified the respiration of the thyroid parenchyma only in a medium dose (1.5 mg). (auth)

8751 PASSAGE OF STRONTIUM-90 AND CALCIUM-45 THROUGH THE PLACENTA IN RATS. Yu. D. Parfenov and A. A. Yusupova. Bull. Exptl. Biol. Med. (USSR) (English Transl.), 57: 314-17(Mar. 1964). Translated from Byul. Eksperim. Biol. i Med., 57: 67-70(Mar. 1964).

As the results of a single intraperitoneal administration to rats of 0.4 C/gm of ^{45}Ca and 0.4 C/gm of ^{90}Sr, in equilibrium with ^{90}Y 12 days before mating and 40 days prior to labor the passage of strontium to the fetus through the placenta during pregnancy was found to be discriminated against in favor of calcium. The extent of strontium discrimination, while from the maternal organism it reached the fetus via the placenta, was characterized by an observed ratio of ^{90}Sr/^{45}Ca in the organism of the newborn ratling equaling numerically 0.54 ± 0.07. Comparative volume of strontium and calcium in the maternal skeleton during pregnancy was characterized by observed ratios of ^{90}Sr ± ^{45}Ca which by the time of birth comprised: for cranial bones 1.11 ± 0.08, for the spine –0.97 ± 0.08, and for the femoral bone –1.06 ± 0.06. (auth)

8752 X RADIATION FOR VISUAL BIOPSY OF BONE FOR ESTIMATION OF MINERAL CONTENT. H. Oeser and E. Krokowski (Freie Universität, Berlin). Deut. Med. Wochschr., 86: 2431-4(Dec. 15, 1961). (In German)

The specific absorption of x radiation by bone in the region of ~ 100 kv, and the good contrast produced as a result on x-ray film is related to the bone's content of Ca and P, as well as its greater density as compared to the soft tissues of the body. The effects of soft tissue that surrounds bone can be excluded by use of correction factors established from model studies that use water phantoms. This method of visual biopsy is based on comparative measurement of the darkening of film induced by x rays of ~ 50 kv or 250 kv energy that have passed through calcified tissue. The fine structure of the inorganic mineral substance is due to its crystalline apatite structure. Studies in human bone show that the amount of apatite is related to the age of the bone. The total Ca in the adult human skeleton amounts to ~ 1 kg. The more slowly metabolizing tissues, such as cartilage, aorta wall, tendons, ligaments, contain ~ 20 g of Ca. Bone Ca content decreases with increasing age in all portions of the skeleton an average of ~ 20%. The total amount of Ca decrease in bone is thus ~ 200 g. However, the Ca content of the relatively inert tissues increases about 10 fold, from 20 to 200 g, appearing as calcification of the rib cartilage, deposits in the tendons, the aorta, the larynx, etc. Thus, there is a net transfer of Ca from bone to cartilage and similar tissue, with advancing age. This is not so much a demineralization as a transmineralization, for the total amount of body Ca remains almost constant during this time. These x-ray measurement procedures measure these changes, and in effect biopsy the bone visually to follow the course of transmineralization that occurs with increasing age. (BBB)

8753 ROLE OF THYROTROPIC HORMONE IN IODINE METABOLISM OF EMBRYONIC RAT THYROID GLANDS IN ORGAN CULTURE. B. M. Nataf, E. M. Rivera, and I. L. Chaikoff (Univ. of California, Berkeley). Endocrinology, 76: 35-42(Jan. 1965).

Embryonic thyroid glands of 16–16.5-day-old and 17–17.5-day-old embryonic rats were cultured for 4 days in 4 different media: a synthetic medium; the synthetic medium to which thyrotropic hormone (TSH) was added; the synthetic medium to which serum from hypophysectomized rats was added; and the synthetic medium to which both serum from hypophysectomized rats and TSH were added. Thyroid explants of 16–16.5-day-old embryonic rats made no significant use of added ^{131}I when cultured in the completely synthetic medium. The addition of serum prepared from the blood of hypophysectomized rats increased somewhat the capacity of the explants to metabolize ^{131}I. The addition of TSH had a significant effect on the functional activity of the embryonic thyroid explanted into culture either in the synthetic medium or in the synthetic medium to which serum had been added. In the former, addition of the TSH enhanced utilization of the added ^{131}I, and only in the presence of TSH was the formation of labeled T_4 observed. When embryonic glands of 17–17.5-day-old rats were cultured in the synthetic medium, the ^{131}I that entered the explant was incorporated principally into protein-bound monoiodotyrosine (MIT) and diiodotyrosine (DIT) (MIT-^{131}I/DIT-^{131}I = about 10), and the amounts of labeled thyroxine (T_4) formed were very low. The addition of serum greatly improved the uptake and metabolism of ^{131}I by the explants. Addition of TSH to the synthetic medium accelerated the conversion of MIT to DIT as well as coupling of DIT, and thus formation of thyroid hormones. Addition of TSH to the serum-containing medium improved organification of the ^{131}I concentrated by the explant, which was reflected mainly in its increased incorporation into T_4. However, increased ^{131}I utilization in thyroid glands of 17–17.5-day-old embryonic rats cannot be ascribed to TSH because the serum was prepared from the blood of rats that had been hypophysectomized 6 months previously. (auth)

8754 ^{131}I-UPTAKE IN CERVICAL MUCUS DURING THE MENSTRUAL CYCLE. Hilda E. Parisier, Alberto B. Houssay, Ana C. Zapata, Adela C. Valerga, and Jorge F. Cordero Funes (Centro de Endocrinologia, Buenos Aires). Fertility Sterility, 15: 433-9(Aug. 1964).

The glands of the uterine cervix concentrate ^{131}I and it appears in the cervical mucus in high concentrations. Since cervical mucus undergoes cyclic changes during the human menstrual cycle, a comparison was made of ^{131}I uptake by the cervical mucus during the estrogenic and progestational phases of the sexual cycle in normal women. Two ^{131}I studies were made at 2-month intervals in 12 women. The first was performed between the 12th and 14th days of the cycle (first phase) and the second between the 25th and 27th days (second phase), by injecting intravenously 100 μC ^{131}I. Peripheral blood and cervical mucus were obtained at different intervals 20 to 135 min after the injection. The ratio, mg cervical mucus : μl plasma, called the mucus/plasma ratio (M/P) was calculated for every sample. Curves were obtained by plotting the M/P ratios, the 60-min sample being chosen to represent 100% value in each individual curve. The curve representing the first phase of the cycle increased rapidly during the two hr of the experiment, the 120-min value being 50% greater than the 60-min. The highest value in the second-phase curve was obtained after 60 min, it decreased slowly thereafter. Thus ^{131}I uptake was greater in the progestational phase. This difference coincides with the change of other characteristics of the cervical mucus such as viscosity, osmotic pressure, transparency, rate of secretion, and chemical composition. To find out if the cervical glands are able to concentrate other ions, these experiments were repeated, using ^{24}Na, in three normal women, but Na uptake by the cervical mucus could not be demonstrated. (BBB)

8755 ON THE RETENTION OF CESIUM-137 IN PEOPLE. M. A. Van Dilla (Los Alamos Scientific Lab., N. Mex.). Health Phys., 11: 21-2(Jan. 1965).

Cesium-137 retention following four cases of accidental contamination was measured as a function of time in the Los Alamos human spectrometer and counter. Inhalation was the primary route in at least three of these exposures. A simple exponential function fits the data well, the biological half time averaging 128 days. (auth)

8756 FATE OF THE IODINE RADIOISOTOPES IN THE HUMAN AND ESTIMATION OF THE RADIATION EXPOSURE. J. F. Colard, W. G. Verly, J. A. Henry, and R. R. Boulenger (CEN, Mol, Belg.). Health Phys., 11: 23-35 (Jan. 1965).

Fate of the iodine isotopes and resulting organ exposures were studied using a four-compartment model previously proposed to account for the metabolism of this element. Mathematical equations were established for this model from biological data accepted in the human. They were used to calculate the amounts of iodine-131 in the thyroid and in the remaining body as a function of time in case of a single or a chronic contamination; in the latter case three phases were considered: rise, equilibrium, and decrease after removal of the contaminating source. The importance of the daily stable iodine intake from the food was emphasized. Some of the theoretical results were checked by experiments on eight volunteers. Calculations were extended to nine other iodine isotopes in order to determine the exposure doses of the thyroid and the remaining body for a single or a chronic contamination; maximum permissible concentrations in water and in air were also computed. It appears that some I.C.R.P. recommendations for maximum permissible body burden must be revised. (auth)

8757 EXPERIMENTAL UPTAKE OF STRONTIUM-85 BY FRESH-WATER ORGANISMS. W. A. Brungs (Robert A. Taft Sanitary Engineering Center, Cincinnati). Health Phys., 11: 41-6(Jan. 1965).

Factorial studies were conducted to determine the effects of variable concentrations of calcium, magnesium, sodium, and potassium on the uptake of dissolved strontium-85 by small bluegills, *Lepomis macrochirus*. The distribution of strontium-85 introduced to a pond containing macrofauna indigenous to the Midwest was also investigated. Of the four cations tested, only calcium was found to have a significant effect within the experimental range on the uptake of strontium-85 by small bluegills. Data from the pond uptake study indicate that after the 80-day experimental period only 25% of the strontium-85 remained in the dissolved phase. The total calculated activity in the experimental fauna never exceeded 0.5% of the amount added. The remaining radioactivity was associated with the substrate. The data also indicate that strontium-85 accumulation is related to age of the test organisms. (auth)

8758 ABSORPTION OF STRONTIUM-90 IN MAN. Minoru Fujita (Japan Atomic Energy Research Inst., Tokyo). Health Phys., 11: 47-50(Jan. 1965).

Analyses were performed with reference to the levels of ^{90}Sr and stable calcium in diet and excreta of man. From the data obtained, the absorption of Sr was estimated. Four healthy volunteers received the same diet for 7 periods, each period consisting of five consecutive days, but, except for the periods examined the subjects consumed any food they liked. The given diet contained nearly 0.55 g of Ca per day. The daily intake of ^{90}Sr ranged between 7 and 13 $\mu\mu$C according to the fallout levels in the diets. The absorption coefficient, f_1, per 5-day period of the four volunteers averaged about 0.38 with a large fluctuation of from 0.09 to 0.63. However, values of f_1 over a considerable time around two periods ranged between 0.20 and 0.32, making a strong contrast with the range between 0.09 and 0.48 obtained for the same 5-day period. (P.C.H.)

8759 FUNDAMENTAL STUDIES ON THE CONTAMINATION OF MILK BY RADIOACTIVE STRONTIUM SPECIALLY, ON THE MECHANISM OF CONTAMINATION. Akira Yuyama. Iwate Daigaku Nogakubu Hokoku, 6: 49-80 (1962). (In Japanese)

The mechanism of milk contamination by radiostrontium was investigated by administering ^{45}Ca and ^{89}Sr to lactating goats. Metabolism changes in these animals were also observed. Experimental methods and results are discussed. (J.R.D.)

8760 CHEMICAL MECHANISMS UNDERLYING THE BIOLOGICAL MECHANISMS OF THE AGING PROCESS. Johan Bjorksten and Fred Andrews (Bjorksten Research Foundation, Madison, Wis.). J. Am. Geriat. Soc., 12: 627-31(July 1964).

New data related to the chemical mechanism underlying the biological mechanism of somatic mutation as a factor in aging are discussed. It is noted that cell cross-linkage is the initial step in aging and ultimate destruction of the cell. (J.R.D.)

8761 PLACENTAL TRANSFER OF F^{18} IN SHEEP. James W. Bawden, A. Stark Wolkoff, and Charles E. Flowers, Jr. (Univ. of North Carolina, Chapel Hill). J. Dental Res., 43: 678-83(Sept.-Oct. 1964).

A surgical technique was employed on eight pregnant ewes to gain access to the maternal and fetal circulations with the lamb *in utero*. Injections of ^{18}F (2 mC) were made into the animals in order to study various aspects of maternal-fetal ^{18}F exchange. The data revealed that maternal plasma clearance of ^{18}F is quite rapid and that fetal plasma levels are relatively low when compared to maternal levels. Uptake in fetal dental and skeletal tissues was shown. Fetal incisor teeth yielded from 800 to 1500 cpm/g (wet wt) and bone samples counted 700 to 1000 cpm/g (wet wt). When ^{18}F was injected into the lamb a 2-ml blood sample drawn from the ewe one min after injection showed no detectable activity. However, samples drawn at 6, 13, and 22 min yielded between 250 to 300 cpm. The observed low fetal plasma ^{18}F levels may be the result of one or both of two possibilities: (1) the placenta may impose some degree of restriction on transfer of ^{18}F from the mother to the fetus, and (2) rapid clearance of the ^{18}F from the fetal circulation may take place in a manner similar to maternal plasma clearance. It is pointed out that the placenta in the sheep is of the syndesmochorial type and is morphologically different from the hemochorial placenta of the human. Materials transferred across the placenta must pass through a layer of endothelium and a layer of connective tissue which are not present in the hemochorial placenta. (BBB)

8762 DISCRIMINATION BETWEEN ALKALI METAL CATIONS BY YEAST. I. EFFECT OF pH ON UPTAKE. W. McD. Armstrong and A. Rothstein (Univ. of Rochester, N. Y.). J. Gen Physiol., 48: 61-71(Sept. 1964).

Extracellular pH markedly influences the ability of yeast cells to discriminate between K^+ and Na^+, with K^+ favored to a greater degree at low pH. Studies of the kinetics of uptake of individual alkali metal cations by fermenting yeast indicate three zones relative to pH. Between pH 6 and 8, H^+ has no effect. Below pH 4, H^+ competitively inhibits the transport of each cation. Between pH 4 and 6, H^+ acts kinetically as a predominantly non-competitive inhibitor. Both effects can be reversed by increasing the concentrations of cations. However, the concentrations required to reverse the competitive effect are considerably lower than those required to reverse the apparently non-competitive effect. It is suggested that H^+ and the alkali metal cations can combine with two sites, a transport or carrier site, and a second, non-transporting site that influences the maximal rate of transport. Because the non-competitive inhibitory effect of H^+ is considerably greater on the other cations than on K^+, the discrimination in favor of K^+ is increased severalfold at low pH, beyond that predicted on the basis of the relative affinities for the transport site. (auth)

8763 CALCIUM, STRONTIUM, AND PHOSPHORUS UTILIZATION BY CHICKS AS INFLUENCED BY NUTRITIONAL AND ENDOCRINE VARIATIONS. Paul E. Waibel and Frank R. Mraz (Univ. of Tennessee, Oak Ridge and Univ. of Minnesota, St. Paul). J. Nutr., 84: 58-64(Sept. 1964).

A study was conducted to determine the influence of various factors simultaneously on absorption and retention of Ca, Sr, and P under in vivo conditions. White Plymouth Rock chicks, 14 days old, were administered ^{45}Ca, ^{89}Sr, and ^{32}P, orally or intramuscularly, along with hormones, vitamins, and carbohydrates. Vitamin D had marked effects upon the tibia deposition of orally administered Ca. Since the treatments had no effect on intramuscularly administered Ca, it was concluded that the effects shown were on absorption. Lactose did not result in improved Ca absorption. Cortisol decreased Ca absorption regardless of vitamin D status. Essentially the same effects were shown with orally administered Sr as with orally administered Ca except that the magnitude of absorption was considerably less. High levels of vitamin D as well as administration of cortisol decreased the deposition of orally administered Sr. Intramuscularly administered Sr with glucose and lactose showed decreased tibia deposition with increasing vitamin D levels. Chicks receiving cortisol showed a highly significant reduction in deposition of intramuscularly administered Sr. In most instances, orally and intramuscularly administered P was deposited with equal efficiency. The vitamin D and cortisol effects agreed closely with those of orally administered Ca. Administration of estrogen and testosterone did not increase Ca retention as reported previously in sexually immature pullets. Estrogen actually resulted in decreased retention of ^{45}Ca, ^{89}Sr, and ^{32}P by bone. This agrees to a limited extent with the stated effect of estrogen in assisting in the removal of Ca from the bone into circulation; however, there was no increase in serum Ca due to estrogen. Estrogen, however, caused a decreased level of serum P, which might result in decreased calcification and therefore decreased deposition of all three isotopes. (BBB)

8764 AUTOHISTORADIOGRAPHY IN ELECTRON MICROSCOPY. USE OF ^{35}S AND ^3H. R. Moricard and S. Gothie (Hôpital Broca, Paris). J. Physiol. (Paris), 55: 171-3 (1963). (In French)

Autoradiography combined with electron microscopy was used to localize radioactive atoms at the level of ultrastructures in the cell, and a study was made of the modifications of localization in the phases of cellular activity. Very thin tissue sections were covered by a thin layer of fine-grain sensitive emulsion (Ilford K_5 was used here undiluted, following a published technic). In the first study uterine cervical cells of a guinea pig which had received 2 mC/kg of $Na_2{}^{35}SO_4$ intravaginally 6½ hr before being sacrificed were observed. The optic image showed the concentration of the isotope in the cylindrical cervical epithelial cells. Autohistoradiography showed some grains of silver reduced in the emulsion above the cervical secretion. The second study was of the ovary of an adult rabbit injected with $Na_2{}^{35}SO_4$; the rabbit received 0.5 mC of Na_2SO_4 per kg 10 hr before being sacrificed. Autohistoradiography after one month allowed the localization of some grains of reduced silver in the region of the follicular fluid and in the cytoplasm of follicular cells. It was concluded that autohistoradiography combined with electron microscopy allows the distinct localization of labeled molecules in relation to certain ultrastructures, and that this method should allow the study of kinetic aspects of cellular metabolism on a level of these ultrastructures. (BBB)

8765 STUDIES ON RADIATION INJURY TO DOMESTIC ANIMALS BY RADIOACTIVE MATERIALS. I. EFFECT OF INTERNAL IRRADIATION ON THE CHICKEN BY P^{32}. 1. ABSORPTION, DISTRIBUTION, EXCRETION AND IRRADIATION DOSE OF EACH ORGAN. Osamu Matsuoka, Miyoshi Ikeda, and Yoshio Ohkubo (Tokyo Univ.). Nippon Juigaku Zasshi, 20: 151-7(1958). (In Japanese)

Phosphorus-32 was administered to the chicken and changes in absorption, excretion, and distribution after administration, and the resulting changes in various organs were studied. In the case of β-emitter as in the case of ^{32}P, the irradiation dose had a great differentiation among the organs. The effects of ^{32}P were much greater in the bone marrow than in other organs. (P.C.H.)

8766 EXPERIMENTAL STUDIES ON CONTAMINATION OF MILK WITH RADIOACTIVE STRONTIUM. Osamu Matsuoka, Yoshikazu Enomoto, and Yoshio Ohkubo (Tokyo Univ.). Nippon Juigaku Zasshi, 24: 201-14(1962). (In Japanese)

Radioactive Sr and Ca were given to rabbits and rats in fundamental studies on contamination of milk with fission from fallout. The isotopes were applied singly, injected daily, or allowed to ingest daily ad libitum as contained in drinking water. Transfer of ^{89}Sr and ^{45}Ca to the milk was determined by assaying the radioactivities of the rabbit milk, which had been milked artificially and the radioactivities of suckling rats. By these methods, the dynamic movement of Sr in the animal body was studied. As a result, it was found that 2% of the Sr orally ingested had been transferred to the milk. Studies were also made on the effect of full dose of carrier and non-radioactive Ca given at the same time with the isotope. The chemical form of ^{89}Sr in rabbit milk was investigated by means of alcohol coagulation, determination of isoelectric point, and ultracentrifugation and it was found that ^{89}Sr was bound to casein in milk. Cow's milk mixed with ^{89}Sr and ^{90}Y in vitro was coagulated by rennet and most of the added radioactivity was found in the coagulated fraction. The rate of danger in transference of ^{90}Sr to the milk product is discussed. (auth)

8767 RETENTION OF RADIOCAESIUM BY THE RAT AS INFLUENCED BY PRUSSIAN BLUE AND OTHER COMPOUNDS. V. Nigrović (Kernforschungszentrum, Karlsruhe, Ger.). Phys. Med. Biol., 10: 81-92(1965).

The effectiveness of several compounds in suppressing the enteral absorption of ^{137}Cs in rats was tested. All agents were found to be ineffective, with the exception of sodium tetraphenylborate, potassium ferrocyanide, and, in particular, ferric ferrocyanide (Prussian Blue). The decrease in enteral absorption of ^{137}Cs by oral administration of PB is dependent upon dose and time of administration. The maximal effect achieved is the reduction of the body-burden by 99%. Repeated oral administration of PB also enhances substantially the excretion of parenterally administered ^{137}Cs. This effect was found to be independent of the time when treatment was started. No toxic side effects of PB were observed. (auth)

8768 INFLUENCE OF FOLIAR LEACHING ON ROOT UPTAKE AND TRANSLOCATION OF CALCIUM-45 TO THE STEMS AND FOLIAGE OF PHASEOLUS VULGARIS. R. A. Mecklenburg and H. B. Tukey, Jr. (Cornell Univ., Ithaca, N. Y.). Plant Physiol., 39: 533-6(July 1964).

Young bean plants were placed in ^{45}Ca-labeled nutrient solution and were immediately leached with an atomized distilled water mist for up to 96 hours. Other bean plants in the ^{45}Ca-labeled solution were grown without leaching in 4 different environments. The rate of root uptake and translocation of ^{45}Ca to the stems and foliage (including ^{45}Ca in leachates) was greater per gram dry weight in plants that were leached than in plants that were not leached. This was true whether the leached plants grew (dry weight) faster than, slower than, or the same as the nonleached plants. Foliar leaching reduced the dry weight accumulation of stems and foliage. Thirty to 40% of the recently root-absorbed calcium was leached during a 4-day leaching period. (auth)

8769 EFFECT OF DESFERRIOXAMINE B-METHANE SULFONATE (DFOM) ON REMOVAL OF PLUTONIUM IN VITRO AND IN VIVO. Marcia W. Rosenthal and Arthur Lindenbaum (Argonne National Lab., Ill.). Proc. Soc. Exptl. Biol. Med., 117: 749-50(Dec. 1964).

An ultrafiltration screening technique was used to determine the effectiveness of desferrioxamine B-methane sulfonate (DFOM), a therapeutic agent that forms complexes with ferrous and ferric iron, in binding plutonium under physiological conditions. Although DFOM increased the fraction of plutonium ultrafilterable from blood plasma, the only effects when given intraperitoneally to plutonium-poisoned mice were the prevention of further uptake of plutonium in the bone after initiation of therapy and a small rise in urinary plutonium. (auth)

8770 VALUE OF THE ^{24}Na CLEARANCE INJECTED IN THE GASTROCNEMIUS MUSCLE FOR STUDIES OF THE OBSTRUCTIVE VASCULAR DISEASES OF THE LOWER ARTERIES. S. Romeo and G. Gasso (Università, Catania, Italy). Radiobiol. Latina, 6: 577-86(Oct.-Dec. 1963). (In Italian)

The tissue clearance of a dose of ^{24}Na injected in the gastrocnemius muscle was studied in 33 patients suffering from obstructive vascular diseases of the legs. From the results obtained, it was concluded that this method may be useful for diagnosis of the said vascular diseases, although there exist some limitations connected with the nature of the radioelement employed. (auth)

8771 METHOD OF REABSORPTION OF TRACES OF RADIOACTIVITY INJECTED INTRAMUSCULARLY. C. Martinenghi, A. Riccardi, and E. Castellano (Università, Milan). Radiobiol. Latina, 6: 619-28(Oct.-Dec. 1963). (In Italian)

With the aim of reducing the radiation dose absorbed by the kidney, renal scintigraphy with ^{131}I-hippuran was injected intramuscularly in association with hyaluronidase. The study of reabsorption of a solution containing radiohippuran injected in the muscles of the thigh showed that the reabsorption process appeared to be a relatively simple process which could be well expressed by an exponential function. Hyaluronidase caused a considerable increase of the absorption speed by reducing to less than half, the time of reduction to LD_{50} at the site of injection. Any variation of the technique of injection, and particularly the combination with substances having a specifically vasomotor action, increased the individual variability with relationship to the different individual sensitivity to the pharmacodynamic action of the substance added. The variations of the reabsorption time lead to considerable differences of the radiation dose absorbed by the muscle, the kidney, and the organism as a whole. (auth)

8772 METABOLIC STUDIES WITH Zn-65. II. THE INFLUENCE OF GESTATION ON THE DISTRIBUTION OF THIS ISOTOPE IN FEMALE RABBITS AFTER INTRAMUSCULAR INJECTION, AND IN THEIR OFFSPRING. B. Ribas, Isabel Pire, Carmen Garcia del Amo, and A. Santos Ruiz (Instituto Espanol de Fisiologia y Bioquimica, Madrid). Rev. Espan. Fisiol., 19: 83-94(June 1963). (In Spanish)

It has been suggested that there might be a relation between zinc and the functions of reproduction. Most of the work carried out in this connection has been on the male reproductory organs. The results presented were obtained in a study of the distribution of ^{65}Zn in normal and gestating female rabbits, injected intramuscularly with isotonic and sterile solutions of $^{65}ZnCl_2$ at a dose of 100 mC/kg of body wt and killed 24 hr after inoculation. The ^{65}Zn used was in the form of a concentrated solution of $^{65}ZnCl_2$, with a specific activity of 0.5 mC/mg. The period of gestation lasts ~ 30 days, so that 9, 14, 19, 24, and 27 days were used for the tests. One lot was kept for control purposes, and these were inoculated after giving birth to their young and were kept with the litter for five days in order to study the passage of the ^{65}Zn to the young through the milk. The organs, after suitable preparation, were measured for radioactivity with a well counter. The milk was measured directly, after dilution for the high isotope content which it presented. The figures for ^{65}Zn found in normal females are in agreement with those found on injecting the rabbits by other methods, and with those found by other authors. The kidney and, to a lesser degree, the adrenal glands were the only organs in which the level of ^{65}Zn increases constantly until the end of the experiment. In the organs of rapid accumulation such as liver and pancreas, there is a rapid decrease in the concentration of the isotope as gestation advances. In the organs of slow accumulation, the brain and bones especially, the levels remain noticeably constant and low, as expected, as 24 hr is not long enough to have any influence on these figures. In the other organs the levels tend to decrease slowly as gestation advances. Keeping the mother with her litter and killing the offspring successively, gave in the organs of the young analogous values as those of the mother, except in the liver, in which the level was much higher in the young than in the mother. This value was in agreement with data found for other animals in analogous experiments. The elimination by the milk shows the importance of this means of transmission, for in five days up to 70% of the dose received by the mother was eliminated and passed to her young in this way. This is a strong contamination potential, since ^{65}Zn, with a sufficiently long half life (245 days), is widely distributed in the biosphere, as is a product of fission of uranium and plutonium. (BBB)

8773 SIMULTANEOUS MEASUREMENT OF BROMSULPHALEIN AND COLLOIDAL RADIO-ACTIVE GOLD (Au^{198}) CLEARANCES IN NORMAL RATS. P. Berthelot, C. Sicot, B. Desbuquois, J.-P. Benhamou, and R. Fauvert (Hopital Beaujon, Clichy, France). Rev. Franc. Etudes Clin. Biol., 9: 232-2(1964).

A technique is described for the simultaneous measurement in the rat of the fractional clearances of bromsulfalein and ^{198}Au, using less than 1 ml of blood. Normal results are illustrated and briefly discussed. The method, which can easily be repeated in the same animal, will be used in studying experimental cirrhosis in rats. (Excerpta Med., Sect. XXIII, 1: (Nov. 1964))

8774 ACCUMULATION OF RADIOACTIVE ISOTOPES OF PHOSPHORUS, YTTRIUM, IODINE AND MERCURY BY LARVAE OF AQUATIC INSECTS. A. B. Getsova and G. A. Volkova (Zoological Inst., Leningrad). Zool. Zh., 43: 1077-80(July 1964).

Experiments conducted on Glyphotaelius punctatolineatus Retz., Halesus interpunctatus Zett., Eristalis tenax L., *Cloën dipterum* L., *Aeschna grandis* L., *Lestes sponsa* Hans, and *Leucorrhinia rubicunda* L. using ^{32}P, ^{91}Y, ^{131}I and ^{203}Hg showed that there was maximum accumulation of yttrium by most of the species investigated, the next highest being mercury. There was high accumulation of phosphorus by only two species: *E. tenax* and *G. punctatolineatus*; all species showed least accumulation of iodine. Highest accumulation of all four elements was consistently demonstrated by *G. dipterum*, followed by *G. punctatolineatus*, while *A. grandis* demonstrated lowest accumulation. (OTS)

8775 CHARACTERISTICS OF THE RAT GASTROINTESTINAL MUCOSA DURING THE ABSORPTION OF ALKALINE EARTHS. Carol Silber Marcus. Thesis, Ithaca, N. Y., Cornell Univ., 1964. 126p.

Various characteristics of the intestinal mucosa were explored under the influence of a number of treatments. It was found that the cells of the intestinal mucosa do not significantly swell, shrink, or change their water concentration during alkaline earth absorption. Mucosa samples of sections of the gastrointestinal tract were analyzed for stable calcium and magnesium in the presence of various treatments. Fasting somewhat decreased the level of stable calcium below that seen in normally fed rats, while lactose decreased it even more. In ileal segments, it was found that a high-calcium solution promoted a higher level of calcium in the mucosa than did a low-calcium solution. Calcium levels in plasma were measured, and it was found that the concentration in plasma of the mesentery vein was the same as that in plasma of the vena cava. Lactose decreased the plasma calcium concentration below that found in fed or fasted rats, both of which were the same. Magnesium did not parallel the behavior of calcium, as strontium often does. Fasted and lactose-dosed rats showed an increase in mucosal magnesium over that found in fed rats. The ileum mucosal magnesium concentration was the same in rats given high and low calcium solutions. Plasma levels of magnesium were lower in lactose-dosed rats than in fed or fasted rats, both of which were the same. Using radioisotope tracers in the ileum, it was shown that there is a barrier of some sort, which acts to prevent strontium-85 from leaving the intestinal mucosa and surrounding tissue at the onset of absorption. A mathematical treatment of data for the computation of the strontium/calcium discrimination factor is described. (A.G.W.)

8776 THE ACTION OF THE CHEMICAL MUTAGEN, DIETHYL SULFATE ON BARLEY. Robert E. Heiner. Thesis, Pullman, Washington State Univ., 1963. 114p.

Dormant seeds of *Hordeum vulgare* var. Himalaya were exposed to varying concentrations of diethyl sulfate (DS) at closely controlled temperatures. The biological effects induced in barley by DS were compared with those produced by x and gamma radiations. Injury to barley seed caused by treatment with DS solutions differed from that caused by radiation in that the characteristic leaf-flecking of M_1 seedlings was not observed. The relative absence of leaf-flecking appeared to be related to the low frequency of chromosome aberrations observed at the first mitosis of germinating seeds and in the microsporocytes of M_1 plants. Sterility was observed in plants grown from seeds treated with diethyl sulfate; however, this sterility could not be accounted for on the basis of induced chromosome interchanges. Diethyl sulfate treatments were found to induce as high as 110 chlorophyll mutations per 100 M_1 plants and 43 chlorophyll mutations per 100 M_1 spikes. Over 70 per cent of the plants survived. Radiations induced up to 32.5 mutations per 100 M_1 plants and 12.6 mutations per 100 M_1 spikes. Treatment techniques were designed, which markedly improved the mutagenic efficiency of the agent. Diethyl sulfate was then shown to compare quite favorably with ethyl methanesulfonate in mutagenic efficiency. The mutagenic efficiency of diethyl sulfate was found to be easily altered by various modifying factors including (1) treatment time and concentration, (2) hydrogen ion concentration, (3) temperature, (4) aeration of the treatment solution, (5) size of the seed, (6) post-treatment soaking, and (7) the presence of the hulls on the seed. The genetic nature of the induced mutations was investigated from analyses of segregating progenies. The data suggested that once the mutation is carried on the chromosome level, several cell initials, probably four, form the spike. (A.G.W.)

8777 INFLUENCE OF FOLIAR LEACHING UPON PLANT NUTRITION WITH SPECIAL REFERENCE TO ROOT-UPTAKE, TRANSLOCATION, AND LOSS OF CALCIUM. Roy Albert Mecklenburg. Thesis, Ithaca, N. Y., Cornell Univ., 1964. 131p.

Plants were labeled with root-absorbed Ca^{45}, P^{32}, Sr^{89}, or foliar-absorbed $C^{14}O_2$ and the leaves were leached by either immersion in aerated distilled water or misting with distilled water, and the leachate was collected on exchange resins. Ca^{45}, P^{32}, Sr^{89}, and C^{14}-labeled compounds leached from squash leaves (*Cucurbita pepo* L.) were root-absorbed and translocated to the aboveground portions of the same or different plants. Bean plants (*Phaseolus vulgaris* L.) were grown through an entire life cycle on the nutrients in foliar leachates. Foliar leaching and nutrient recycling resulted in the external redistribution of nutrients such as calcium from mature leaves to the young rapidly growing areas of the plant. Strontium-89 sprayed on potato foliage (*Solanum tuberosum* L.) was leached by distilled water mist, carried to the root medium, absorbed by the roots, and translocated into the tubers. Thus underground storage organs are liable to indirect contamination by fallout strontium. The rate of root-uptake and translocation of Ca^{45} to bean shoots was increased by 30 to 40 percent in plants that were misted as compared with plants that were not misted. The specific activity of Ca^{45} in the foliar leachate and in the exchangeable, cell-sap, and residue fraction of bean plants growing in a Ca^{45}-labeled nutrient solution was determined. Results indicated that calcium was leached from exchange sites in the leaf and was not leached from within the leaf cells. The volume of misting had little effect upon the loss of calcium, as long as the leaves were wetted. A hypothesis was developed for the mechanism of the foliar leaching of calcium. (Dissertation Abstr., 25: No. 3, Sept. 1964)

8778 USE OF ^{131}I IN THYROID TESTS. R. R. Pieroni, J. Kieffer, A. Coelho, et al. (Universidad, Sao Paulo, Brazil). p.259-68 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. I." New York, Academic Press, 1962. (IEA-73). (In Portuguese)

The various ^{131}I tests, including localization of thyroid tumor metastases, which are current in basic training work, are compared. An analysis was made, for the different techniques employed, of the distribution curves relating to uptake data, protein-bound iodine in the blood (^{127}I), urinary excretion, etc., in normal, hyperthyroid, and hypothyroid subjects, and the various physical factors liable to affect these curves are pointed out. The results are based on a study of over 1500 cases, in all of which 2-, 24-, and 48-hr thyroid uptake and 24- and 48-hr urine excretion were measured. With over 300 patients, the study included the determination of protein-bound iodine (^{127}I) as well as the conversion ratio and PB^{131}I. In over 200 cases comparisons were made with saliva measurements. At the same time iodine distribution phase models were examined and improved methods are suggested in each case for arriving at more definite data on thyroid function. A number of cases are discussed with proven synthesis and other disorders (thyroid-cancer metastases), among which it is considered that the X factor can be identified. Almost 800 thyroid charts were analyzed and the cold nodules were correlated with thyroid cancers (checked by pathological-anatomical examinations). Attention is drawn to the high frequency of the iodine-hungry simple goiters recognized by the Werner test. (auth)

8779 RADIONUCLIDE DOSES TO INFANTS AND CHILDREN: A PLEA FOR A STANDARD CHILD. J. G. Kereiakes, R. A. Seltzer, B. Blackburn, and E. L. Saenger (Univ. of Cincinnati and Public Health Service, Cincinnati). 18p. (CONF-642-17)

From Health Physics Society, Cincinnati, June 1964.

Dose levels for infants and children are considered. A series of standard children of various ages was derived by supplementing values of the fiftieth percentile for heights and weights of certain ages with pertinent information on organ weights and physiology. Age groups selected for the study included: newborn, 1, 5, 10, and 15 years old. Average absorbed doses in millirads per microCurie administered were then calculated for the whole-body and/or critical organ using the general beta and gamma dose formulas. The average whole-body doses ranged from 10 to 20 times greater in the newborn than standard man for a given quantity of administered radioactivity. Furthermore, since infants and children breathe more air on a per weight basis than an adult and since their water intake is also greater on a per weight basis, maximum permissible concentration guides based upon standard man do not apply to younger individuals. (P.C.H.)

8780 EVOLUTION OF THE YIELD OF EQUIVALENT DOSE DELIVERED TO THE THYROID GLAND AFTER INSTANTANEOUS INHALATION OF TELLURIUM-132. J. Le Grand and M. Dousset (Commissariat a l'Energie Atomique, Fontenay aux Roses, France). 33p. (CONF-642-22). (In French)

From Health Physics Society, Cincinnati, June 1964.

Kinetics of the absorption of tellurium and iodine through the routes of entrance, lung and digestive tract, were investigated. With the systematic application of the mathematical method of the convolution product to the several stages of the intestinal transit, the entry functions of tellurium and iodine into the body were calculated. Differential equation systems corresponding to the kinetics of the four-compartment model adopted for tellurium and iodine in the body were set up and solved. The equivalent dose-rate delivered to the thyroid by iodine-132 originating from inhaled tellurium-132 was estimated. Variation of this dose-rate as a function of time is presented graphically. The dose rate passes through a maximum value equal to 4.10^{-3} Rem.h^{-1} per μC of inhaled tellurium-132, 13 hours approximately after inhalation. The cumulated dose reaches a value of some 0.25 Rem per μC and half the dose is delivered during the first 60 hours. (P.C.H.)

Radiation Effects

Refer also to abstract 9227.

8781 (AD-422394) EFFECTS OF RADIATION COMBINED WITH ANESTHESIA AND TRAUMA. Progress Report, July 1, 1961—September 30, 1963. Howard L. Zauder (Yeshiva Univ., New York. Albert Einstein Coll. of Medicine). Contract DA-49-007MD962. 113p. $9.60(OTS).

Results are reported from a study of variations in response of dogs and rats to x radiation, tourniquet shock, trauma, and anesthesia. Results showed that tourniquet shock was the only insult somewhat modified by the time of exposure. Whereas a 250 Rad mid-line dose in the dog represented an LD-50 at 30 days without anesthesia or surgical trauma, a dose of 190 Rads became an LD-80 dose when anesthesia and/or skin grafting was superimposed upon the radiation. The takes of autologous skin grafts in control animals was 90%. Doses of radiation of 190 to 200 R had no effect on the number of takes. Animals that were exposed to greater doses did not survive longer than the 21 days necessary to evaluate a successful graft. Of the parameters thus far investigated, few consistent changes in metabolism were found that could be associated with irradiation, except for increase in liver weight following irradiation and starvation, and the appearance of an abnormal component in the blood of irradiated dogs. This has not been identified nor is its significance known. (auth)

8782 (BNL-7790) DIAGNOSIS OF RADIATION INJURY. Eugene P. Cronkite (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 16p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The diagnosis of radiation injury embraces well-known medical principles including a careful history, repetitive physical examinations, repetitive studies of blood cells and bone marrow, and the evaluation of the preceding in view of radiation dose estimates and the type of accident. Good radiation dosimetry can be helpful but is not essential for the diagnosis or management of radiation injuries if the physician is aware of the signs and symptoms of radiation injury. The symptoms of radiation injuries of varying degrees are reviewed. Brief descriptions are included of types of accidents that have occurred that resulted in radiation injuries sufficiently severe to necessitate medical care. (14 references.) (C.H.)

8783 (BNL-8571) EFFECTS OF FAST NEUTRON ON LARGE ANIMALS. V. P. Bond (Brookhaven National Lab., Upton, N. Y.). Sept. 28, 1964. Contract AT-30-2-GEN-16. 24p. (CONF-640904-1) Dep.(mn); $1.00(cy), 1(mn) OTS.

From Tripartite Technical Cooperation Program Panel N-1 Sub-Group N, Toronto.

Data are presented on mortality response of large animals to fast neutrons as compared to x or gamma rays, as a function of energy and geometry. Data on dogs are compared with data on mice and rats. The RBE of fast neutrons over a wide energy spectrum in large animals is 1.0 or less. This figure represents an RBE in the radiobiological sense, i.e., uniform deposition of energy, and comparison of the ratio of absorbed doses in tissue, resulting in 50 per cent mortality. Considerations of energy and geometry encountered in the field with fast neutrons would tend to make the effectiveness factor less than the RBE of 1, although not more than perhaps 20%. Additional considerations such as greater surface damage with neutrons vs. gamma would indicate that an effectiveness factor of approximately 1 is appropriate. It would appear that the best parameter in terms of which to predict casualty rates would be the readings of at least 1 dosimeter placed on the trunk of the individual during exposure. Placing 2 dosimeters, perhaps on a belt, one front and one rear, would increase the accuracy of predictions somewhat, and no doubt would increase knowledge of dose-effect relationships in man should the occasion ever arise to utilize such dosimeters. The difficulties of dealing with partial body exposure sustained as a result of shielding by material or other personnel is pointed out. (auth)

8784 (CONF-813-1) A PREDICTION OF EARLY RADIATION LETHALITY USING AN EFFECTIVE DOSE. Hal Hollister, A. R. Vincent, and John W. Cable (Division of Biology and Medicine, AEC). Sept. 1964. 38p. (TAB-R-4) Dep.(mn); $2.00(cy), 1(mn) OTS.

From 10th Annual and First International Meeting of the Western Section of the Operations Research Society of America, Honolulu, Sept. 1964.

The prediction of the incidence of early death in a mammalian species following whole-body exposure to ionizing radiation from an external source is discussed. Emphasis is placed on the dependence of the lethal response on the time characteristics of the exposure dose, implications of a long-standing hypothesis of H. A. Blair on recovery from radiation injury and the interpretation of experiments to estimate quantal-response radiation-tolerance distributions. The usual method for making practical predictions of early lethality based upon equivalent residual dose or biological damage dose depends upon a tacit assumption of constant variance for the underlying tolerance distributions. There is evidence suggesting that such an assumption is at best fragile. Future experiments are needed and should be designed to lead to conclusions about the validity of the Blair hypothesis, including the proper values for the arbitrary constants, for a wider range of exposure characteristics and end points, and the assumption of constant variance for the associated tolerance distributions. (31 references.) (auth)

8785 (EUR-1607.e) BONE MARROW TRANSPLANTATION IN IRRADIATED ANIMALS PRODUCTION AND APPLICATION OF PATHOGEN FREE ANIMALS IN RADIATION EXPERIMENT. (Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Rijswijk). 1964. 8p. Dep.(mn).

A new pathological syndrome appeared in the monkey colony that was identified as being similar to X-disease in cattle which is due to intoxication by chlorinated naphthalene. Results are reported from extensive investigations on freezing and storage of autologous bone marrow suspensions from monkeys; the pretreatment of the bone marrow graft in order to try to eliminate the immunologically competent cells from the bone marrow suspensions before the transplantation in mice; the effects of pooled bone marrow on restoration of the hematopoietic function in monkeys; the effect of previous blood transfusions on the sensitivity of the host to homologous bone marrow transplantation in human leukemia patients; specific immunological tolerance of the graft in mouse radiation chimeras; factors influencing the proliferation of foreign bone marrow cells in hamster irradiated host; secondary disease in thymectomized rat to mouse chimeras and in a number of other radiation chimeras; and the production and experimental evaluation of pathogen free and gnotobiotic rat colonies. (C.H.)

8786 (NSA-SP-7011(02)) AEROSPACE MEDICINE AND BIOLOGY. A Continuing Bibliography. A Selection of Annotated References to Unclassified Reports and Journal Articles that were Introduced into the NASA Information System During the Period, June 1964—July 1964. (National Aeronautics and Space Administration, Washington, D. C.). Sept. 1964. 139p.

Approximately 400 references are presented to unclassified reports and journal articles on the biological, physiological, psychological, and environmental effects of simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar effects on biological organisms of lower order and covering related topics such as sanitary problems, pharmacology, toxicology, safety, survival, life support systems, exobiology, and personnel factors are included. Subject, corporate source, and personal author indexes are included. (C.H.)

8787 (NP-14448(p.1-12)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. I. INFLUENCE OF X RADIATION AND VARIOUS CHEMICAL AGENTS ON THE DEVELOPMENT OF A THIOPHOSPHATE-OXIDIZING ENZYME SYSTEM IN THE LIVERS OF MALE RATS. Bernard E. Hietbrink and Marjorie Keshmiri (Chicago. Univ. Air Force Radiation Lab.).

Studies were undertaken to obtain additional information on the mechanisms involved in the inhibitory effect of x radiation on the development of phosphorothioate-oxidizing enzyme activity in the livers of young male rats. The influence of daily injections of various steroids on the development of this enzyme system were studied. It was found that the administration of 2 mgm./kgm./day of estradiol or progesterone inhibited the development of enzyme activity in the livers of young male rats. The administration of 200 R of x ray to the head area at 23 days of age did not alter the inhibitory effects of these compounds. The injection of 2 mgm./kgm./day of pregnandione also inhibited development of phosphorothioate-oxidizing enzyme activity in the livers of young male rats. Daily injection of 2 mgm./kgm. of diethylstilbesterol stimulated the development of enzyme activity during the first 12 days of the injection period but continued injections inhibited the activity of this enzyme system. This dose of androstenedione, like other androgens, stimulated the development of activity. The effect of increased doses of radiation on the development of enzyme activity was tested by exposure of 23-day old rats to 400 R and 600 R of x ray. These doses of x ray, given to the head area, caused a similar degree of inhibition in development of enzyme activity as that produced by 200 R of whole-body or head x radiation. Results of preliminary studies on the influence of head irradiation on the resynthesis of enzyme activity in the livers of partially hepatectomized adult male rats indicated that 600 R of head irradiation caused a slight inhibition in the rate of regeneration of activity at ten days after hepatectomy. (auth)

8788 (NP-14448(p.13-20)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. II. INFLUENCE OF X RADIATION AND CASTRATION ON STEROID-INDUCED INCREASES IN THE ACTIVITY OF A DETOXIFICATION ENZYME IN THE LIVER OF RATS. Kenneth P. DuBois and Florence Kinoshita (Chicago. Univ. Air Force Radiation Lab.).

In connection with previous studies which demonstrated the stimulatory effect of several steroids on the synthesis of a microsomal enzyme system that catalyzes the development of resistance to 0,0-diethyl 0-(methylthio-m-tolyl phosphorothioate (DMP), the effects of pregnandione, androstenedione, and cholesterol were tested to ascertain whether they produced similar effects. Each compound was given at daily doses of 2 mgm./kgm. for several days and the amount of resistance to DMP was measured by determining the amount of inhibition of cholinesterase after various doses of DMP. It was found that daily treatment with all of these steroids induced increases in the detoxification system for DMP. Comparison of the stimulant action of testosterone and progesterone on the detoxification system for DMP in normal and irradiated animals demonstrated that 400 R of x ray does not affect the stimulatory action of these steroids in adult animals. Induction of resistance to DMP in castrated male rats was studied by the administration of progesterone at 2 mgm./kgm./day for 12 days following exposure to 400 R at 23 days of age. The results of these experiments showed that progesterone markedly stimulated induction of the enzyme activity. This effect may be contrasted with the inability of progesterone to stimulate enzyme induction in uncastrated, irradiated animals. (auth)

8789 (NP-14448(p.21-35)) THE EFFECTS OF IONIZING RADIATIONS ON THE BIOCHEMISTRY OF MAMMALIAN TISSUES. III. DEVELOPMENT AND APPLICATION OF A QUANTITATIVE METHOD FOR MEASURING THE INHIBITORY EFFECT OF X RAY ON SYNTHESIS OF MICROSOMAL ENZYMES. Robert A. Neal, Florence Kinoshita, and Kenneth P. DuBois (Chicago. Univ. Air Force Radiation Lab.).

A rapid, quantitative method was developed for measuring the activity of a detoxification enzyme in liver microsomes. Applicability for the detection of inhibition of enzyme synthesis by x irradiation was demonstrated in rats. (C.H.)

8790 (NP-14448(p.116-31)) THE INFLUENCE OF EXPOSURE TO LOW LEVELS OF GAMMA AND FAST NEUTRON IRRADIATION ON THE LIFE SPAN OF ANIMALS. I. SUMMARY OF THE CHRONIC GAMMA AND LOW-LEVEL FAST NEUTRON IRRADIATION PROGRAM. A. Sandberg and J. Doull (Chicago. Univ. Air Force Radiation Lab.).

The effects of daily administration of gamma and fast neutron irradiation on the life span of CF_1 female mice are presented both in regard to the median survival time and the Gompertz transformation of the mortality data. Mice were exposed for the duration of life to daily gamma doses of 7 rep, 17 rep, 24 rep, 43 rep, 54 rep, and 88 rep and to daily fast neutron doses of 0.12 rad, 0.17 rad, 0.29 rad, 0.36 rad, 0.84 rad, 1.43 rad, and 2.68 rad. The life span shortening of groups of mice exposed to daily gamma irradiation increased as the daily dose increased; range of this effect was 20.4% life span shortening for that group exposed to 7 rep/day to 92.6% life span shortening for that group which received 88 rep/day. With the present neutron facility the range of life span shortening was not as great as could be obtained with the gamma facility and the amount of life span shortening ranged from an extension of the life span at 0.12 rad/day to 48.3% for that group which received 2.68 rad/day. The Gompertz transformations of the mortality data for the groups of mice exposed daily to gamma irradiation indicated that both a change in the slope of the curve occurred, as well as an increase in the hypothetical extrapolated rate of mortality, at the initiation of the study. The increase in slope as compared with the control groups was increased as the daily dose was increased. The major change which occurred in the Gompertz transformation of the mortality data of the groups of mice exposed daily to fast neutron irradiation was in the slope of the Gompertz plot. Groups of mice which received fast neutron irradiation and exhibited none or a slight degree of life span shortening exhibited mortality much like the control groups both in respect to the slope of the Gompertz curve and the hypothetical extrapolated mortality rate at the initiation of the study. (auth)

8791 (NP-14556(p.81-110)) RADIATION CARCINOGENESIS IN MAN. (United Nations. Scientific Committee on the Effects of Atomic Radiation).

Data on the induction of cancer in man by ionizing radiations are reviewed. Emphasis is placed on information made available after 1962. It is pointed out that the mechanisms of carcinogenesis in general are not well understood and that most of the data available on radioinduced tumors in man and experimental animals comes from studies of the effects of high doses of radiation. Few data are available on the carcinogenic effects of low doses of radiation. Radioinduced tumors are indistinguishable from cancers arising from other causes. Mechanisms likely to be of importance in the induction of cancer by radiation include direct cellular injuries, including changes in genes and chromosomes; the promotion of growth and development of cells with malignant potential through local injurious effects on related cellular systems and stroma; complex perturbations of cellular and tissue homeostasis; and systemic influences and effects on distant tissues and cells that may result in altered immunological mechanisms, endocrine disturbances, and changes in metabolism and nutrition. Radiobiological investigations suggest that relatively large doses of radiation are required to cause systemic effects or produce observable changes in tissue structure and function and that the major mechanisms in the induction of malignancies by low doses of radiation would probably involve radioinduced mutations or chromosome injuries, or possibly changes in the susceptibility of cells to transformation by viruses, or the effect of radiation may advance in time the control curve of age distribution of tumors or multiply by some factor the age-dependent incidence. Difficulties encountered in all epidemiological studies of human populations are compounded for studies on radiation effects by the fact that in many cases radiation dose determinations are performed long after the irradiation, differences in the radiosensitivity of individuals and population groups, variations in environmental conditions during irradiation, problems of terminology and statement of dose, variations in radiation dose measurement methods, lack of data on total lifetime incidence of tumors and many other factors. Data are summarized from investigations on the incidence of leukemia in Japanese survivors of the atomic bomb attack, American radiologists, English patients treated with therapeutic doses of x radiation for presumed ankylosing spondylosis, children irradiated therapeutically for enlarged thymus, children irradiated *in utero*; other groups medically irradiated from external sources, in patients receiving therapeutic doses of ^{131}I, and in polycythemia vera patients treated with ^{32}P; thyroid neoplasms in Japanese survivors of the atomic bomb, patients therapeutically irradiated from external sources, and in patients treated with therapeutic doses of ^{131}I; skin tumors in patients after therapeutic irradiation; bone tumors in patients after therapeutic irradiation, bone tumors in persons with radium burdens; thorium-related neoplasms; lung cancer in miners handling radioactive ores; and neoplasms in populations exposed to high levels of environmental radiation. (138 references)

8792 (NP-14556(p.111-17)) LIST OF REPORTS RECEIVED BY THE COMMITTEE. (United Nations. Scientific Committee on the Effects of Atomic Radiation).

A list is presented of some 200 reports received by the Scientific Committee on the Effects of Atomic Radiation of the United Nations between March 1962 and July 1964 covering fallout fission products and radioinduced neoplasms in man. (C.H.)

8793 (NYO-2881-1) FINAL SUMMARY REPORT [ON OCCURRENCE IN HUMAN PATIENTS OF TUMORS], NOVEMBER 1961–OCTOBER 1964. D. J. Mewissen (Oeuvre Nationale Belge de Lutte Contre le Cancer, Brussels). Contract AT(30-1)-2881. 36p. Dep.(mn); $2.00(cy), 1(mn) OTS.

A survey of the Belgium population was made on the occurrence of tumors of the bony cavity of the face, with emphasis on the incidence of mastoid carcinomas in persons with possible previous exposure to ionizing radiation with special reference to radium handling in the radium processing industry in Belgium for the past 30 years. Clinical and statistical data pertaining to such cases on file in the Belgian cancer registry were reviewed and individual patients and their families were visited by trained interviewers. Data were transferred to punched cards and analyzed for epidemiological, morbidity, and mortality significance. Not a single case of mastoid carcinoma was found that could be related to occupational exposure during radium processing. It is pointed out that over the 30-yr period there was ample opportunity for exposure to many workers. (C.H.)

8794 (ORNL-TM-940) SYNERGISTIC EFFECT OF ZERO-G AND RADIATION ON WHITE BLOOD CELLS—AN EXPERIMENT FOR THE GEMINI III MANNED SPACE FLIGHT. Annual Report Period Ending June 30, 1964. M. A. Bender (Oak Ridge National Lab., Tenn.). Jan. 1965. Contract W-7405-eng-26. 34p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The synergistic effects of zero-G and radiation on white blood cells will be studied in samples exposed during the Gemini III space mission. Blood will be drawn from 2 donors, one male and one female, about 6 hr before the scheduled liftoff time and sterile heparinized samples will be loaded into sterile chambers which will then be assembled into two identical devices (BIG-I), each containing a total of 10 samples. One BIG-I device will be placed in the Gemini III vehicle 2 hr before liftoff and during the second of the three scheduled 90-min orbits, the blood will be irradiated for 30 min. by one of the astronauts moving a handle of the BIG-I device. The ground control sample will be actuated at the same time. After recovery of the Gemini III vehicle, the BIG-I device will be opened and the blood samples put in culture aboard the recovery vessel. Simultaneously, the ground control samples will be placed in culture at the launch site. Seventy-two hours after the cultures are made, the cells will be fixed and cytological preparations made for analysis together with the dosimeters. Data from 3000 cells will be available for statistical analysis. Development and testing of the experimental design and the experimental device are described. (C.H.)

8795 (SAM-TDR-64-29) INFLUENCE OF X-IRRADIATION ON DEVELOPMENT OF MICROSOME OXIDASE AND REDUCTASE ACTIVITY IN THE LIVERS OF YOUNG MALE RATS. Bernard E. Hietbrink and Kenneth P. DuBois (Chicago. Univ.). Feb. 18, 1964. Contract AF41 (609)-1693. 10p. (AD-601792) $0.50(OTS).

The influence of x radiation on the development of an oxidase in liver microsomes that catalyzes the oxidative desulfuration of phosphorothioates was studied. Exposure of 23-day-old male rats to 200 R or 400 R almost completely inhibited the development of phosphorothioate oxidase activity during the 3-week observation period following radiation. Substantial inhibition of the development of oxidase activity was also observed after exposure of the animals to 100 R. Marked inhibition of the development of the enzyme in the regenerating livers of partially hepatectomized rats was observed following exposure to x ray of 200 R to 600 R. The absence of an inhibitory effect by x irradiation on phosphorothioate oxidizing activity of the livers of adult male rats suggests that the effect of x ray is on some process involved in the synthesis of phosphorothioate oxidase. X irradiation had no effect on the development of reductase activity in the livers of young rats indicating selectivity in the action of x ray on the development of microsome enzymes. (auth)

8796 (USNRDL-TR-783) ABSCOPAL EFFECTS OF WHOLE-BODY X IRRADIATION ON COMPENSATORY HYPERTROPHY OF THE RAT KIDNEY. L. W. Wachtel and L. J. Cole (Naval Radiological Defense Lab., San Francisco). Sept. 18, 1964. 30p.

The weight and DNA content of normal intact and hypertrophying rat kidneys were obtained from several hundred Sprague-Dawley white rats. The effect of whole-body x irradiation with 500 rad and local irradiation to the kidney with 1000 rad, was determined by following the rate and degree of hypertrophy and the DNA content of the kidney. When calculated on the basis of body surface area, a constant ratio of kidney weight and of kidney DNA was found in the normal, non-hypertrophying kidneys of 5 to 12 week-old rats. After 21 days of hypertrophy these values increased approximately 50 per cent over normal in rats 4 to 6 weeks old at the time of nephrectomy. For animals 6 to 14 weeks old at the time of nephrectomy the corresponding increase was only about 20 per cent. Following uninephrectomy and x irradiation with 1000 rad to the exteriorized remaining kidney, 4 week old rats whose bodies were lead-shielded during irradiation showed no body weight retardation, no significant difference in the DNA content of the kidney, and a small but significant decrease in weight increment of the hypertrophying kidney after 21 days. Rats exposed to 500 rad of x rays with the kidney shielded during irradiation, when compared with nonirradiated controls, showed body weight growth retardation, a reduction in the DNA content of the kidney, and a reduction in the amount of kidney hypertrophy 21 days following uninephrectomy. A still greater inhibition of both kidney compensatory hypertrophy and the increase in DNA content of the kidney occurred after 500 rad whole-body irradiation. (auth)

8797 (JPRS-27289) PROBLEMS IN THE MECHANICS OF RADIATION INJURY. A. D. Zurabashvili and B. R. Naneishvili. Translated from p.58-66 of "Voprosy Patoarkhitektoniki Luchevogo Porazheniya," (a publication of the Publishing House of Academy of Sciences, Georgian SSR, Tbilisi, 1962). 6p. (TT-64-51545). $1.00(OTS).

Microscopic studies of tissues from the central nervous system of patients receiving therapeutic doses of high-energy x radiation indicated a definite radiosensitivity of nervous tissue. Results are reported from detailed microscopic studies of central nervous system tissues from mokeys exposed to whole-body radiation from x ray beams, 2000 R γ radiation to the skull from a ^{60}Co source, whole-body neutron irradiation, irradiation of the skull at a dose of 500 R using an x ray beam, or irradiation of the trunk with 500 R x radiation with the skull shielded. The radiation injuries included a primary reaction that developed soon after irradiation, followed by swelling, wrinkling, necrosis, destruction of nerve tissues, and death. (C.H.)

8798 (JPRS-27293) ACUTE BLOODLETTING DURING RADIATION SICKNESS. A. A. Beysebaev (Beysebayev). Translated from Vest. Akad. Nauk Kaz. SSR, 20: No. 5, 48-53(1964). 10p. (TT-64-51549). $1.00(OTS).

The course of radiation sickness in rabbits was moderately severe when they were exposed to general irradiation with x rays in a dosage of 600 R. In healthy rabbits, bloodletting at the rate of 16.5 ml of blood per kilogram of body weight had a stimulating effect on the hemopoietic system. The same bloodletting performed two hours following irradiation eliminated the leukocytosis phase and did not aggravate leukopenia. At the same time, an increase in erythropoietic function of bone marrow was observed. When bloodletting was performed at later dates, on the third and ninth post-irradiation days, the course of radiation sickness was aggravated, with a rise in the mortality rate and shortening of average survival time of the animals. They developed marked and lasting anemia due to inhibition of bone marrow function. Such phenomena warrant the assumption that bloodletting at the height of radiation sickness causes weakening or even an almost total extinction of capacity to mobilize compensatory mechanisms in the organism. (auth)

8799 (JPRS-27343) BLASTOMATOGENIC ACTION OF HIGH-ENERGY PROTONS. V. N. Strel'tsova, Yu. I. Moskalev, and I. K. Petrovich. Translated from Vopr. Onkol., 10: No. 9, 74-6(1964). 6p. (TT-64-51599). $1.00 (OTS).

Rats irradiated once with protons with an energy of 120 and 500 Mev in doses ranging from 25 to 850 Rads develop benign and malignant tumors of the soft tissues, leukemia, tumors of the uterus, ovaries, hypophysis, thyroid, thymus, pancreas, testes, prostate, liver, kidneys, perinephric tissue, lungs, and small and large intestines. The overall frequency of tumors and number of cases of polycentric growth are much higher in females than in males. In females, tumors of the mammary glands, gonads, and hypophysis predominate. In males, tumors of subcutaneous tissue are more common. The threshold values for adenomas and mammary tumors induced by protons range from 25 to 50 Rads. A difference in radiant energy of protons ranging from 120 and 500 Mev has no effect on the qualitative spectrum of the tumors. (auth)

8800 (NP-tr-1204) SEROLOGICAL STUDIES ON THE EFFECT OF X-RAY IRRADIATION ON THE LIVING BODY. Sannosuke Tarusawa. Translated from Iwate Igaku Zasshi, 15: 114-21(Aug. 1963). 13p. (Includes original, 8p.). Dep.(mn); $1.60(fs), $0.80(mf) JCL.

Results are reported from studies on the effects of x radiation on immune reactions in patients undergoing radiotherapy and in rabbits and dogs. It is postulated that the erythema that often develops during radiotherapy is an allergic reaction caused by antigenic response to auto-antibodies formed in irradiated tissues. Data are included from studies on the production of auto-antibody in the serum of rabbits inoculated with irradiated muscle tissue, biochemical and histological studies of the effect of x radiation on nucleic acid metabolism and the production of auto-anti-liver antibody in rabbit liver, the effects of x irradiation of the stomach of dogs on the secretion of gastric juice and its relation to the formation of antigastric antibody, and antigen-antibody response in the lungs of rabbits inoculated tracheally with pneumococci in one side of the lungs. (C.H.)

8801 .CYTOCHEMICAL AND CYTOSPECTROPHOTOMETRIC INVESTIGATIONS ON THE LEUKOCYTES OF RATS IRRADIATED INTERNALLY BY PHOSPHORUS-32. Grigore Turcu, Constantin Dimoftache, Petre Wexler, and Vasile Vasilescu (Inst. of Medicine and Pharmacy, Bucharest). Acad. Rep. Populare Romine, Studii Cercetari Biochim., 7: 109-15(1964). (In Romanian)

Investigations made on leukocytes of rats exposed to internal irradiation with ^{32}P showed that the decrease of the number of leukocytes is a function of the dose administered. The decrease of the lymphocytes and granulocytes with time depended on the skeletal distribution of ^{32}P in the organism. The percentage of granulocytes with intense activity of the alkaline phosphatase increased in parallel with the irradiation dose. The nucleus of the lymphocytes appearing in the blood stream during irradiation differed from the nucleus of normal leukocytes by its tinctorial capacity and the wavelength at the absorption maximum. (tr-auth)

8802 ON THE KETOENOLIC SUBSTANCES AND KETOENOLIC GRANULES. Yukio Hamazaki (Univ. of Okayama Medical School, Japan). Acta Histochem., 16: 1-27(Sept. 30, 1963).

The effect of various agents, including ionizing radiation, on ketoenolic substances (KES) and ketoenolic granules (KEG), the granular form of ketoenolic substances, was studied by histochemical techniques. These granules are widely distributed in the animal kingdom and they tend to appear in large amount in tissues with active function and in cells with rapid proliferation, for example, in animals in the liver, kidney, and cerebrum, and in fetuses especially they appear in large numbers in the organ anlage. When 200 R of whole-body irradiation was given to mice, most of the KEG are lost after three hr, but a small number of coarse granules remains. Their coloration becomes weak and they become clear as if the entire tissue were washed. KES contained in the chromosome also disappear. It is noteworthy that the ketoenolic lipids (KEL) contained in Leydig cells in the testes, cells of the central nervous system, adrenal cortex, and reticuloendothelial system do not lose their staining property, but after irradiation their behavior to

$Ba(OH)_2$ solution differentiation changes so that they lose their coloration property as in the case of KES. KES begin to recover in the liver, brain, and stomach $\sim$9 hr after irradiation. It begins to appear as fine granules first about the periphery of the nucleolus and on the inner surface of the nuclear membrane, then in the outer surface of the nuclear membrane. They then migrate into the protoplasm. In cells which contain KEL, KES recover and gradually develop a resistance against $Ba(OH)_2$ to transform into KEL. KEL are stained by lipid staining methods and distinguished by their radiation sensitivity. Similar findings were obtained by the use of radioisotopes and nitrogen mustard. Since KES may be related to DNA, the behavior of Feulgen-positive substances following x irradiation were studied. The Feulgen original method was applied to various organs of mice exposed to whole-body x irradiation of 600 R. Substances which react positive to Feulgen method gradually decreased after irradiation and after reaching an extreme depletion two days later were restored to normal in about one week. Most sensitive to x rays were nuclei of liver, salivary gland, and the small intestine epithelium, whereas the nuclei of fibrocytes, smooth muscle cells, and lymphatic cells were not sensitive to radiation. It was suggested that KES are the products of DNA decomposition and possess an action resembling folic acid. It was necessary to expose rats to massive radiation doses (1500 to 3000 R) to bring about such effect on the DNA in the tissue as determined by chemical quantitative analysis. (BBB)

8803 STUDIES ON THE ANTIGENIC PROPERTIES AND CHEMICAL STRUCTURE OF IRRADIATED PROTEIN. Sandor Damjanovich, Maria Kavai, and Lorand Kesztyus (Medical Univ., Debrecen, Hungary). Acta Physiol. Acad. Sci. Hung., 24: 409-17(1964).

The antigenicity of ovalbumin solutions was investigated in solutions of various concentrations, prior to and following x irradiation. No qualitative changes were evident in the concentration range studied. Any quantitative changes observed were attributed to alterations in the number of SH-determinant groups. It was concluded that in radioinduced damages of the protein molecule the SH groups exhibit the greatest sensitivity both biologically and radiochemically. (JPRS)

8804 ON THE INFLUENCE OF ULTRAVIOLET RADIATION ON THE BLOOD SUGAR LEVELS IN RABBITS. E. Mietkiewski and R. Klinke. Acta Physiol. Polon., 15: 623-34(1964). (In Polish)

Sixty-one rabbits were used in the experiments. The thoroughly depilated skin of the back was irradiated over an area of 100 cm^2 for 30 minutes, or daily for 20 minutes during 3 weeks. The irradiations were performed with a quartz lamp and filters transmitting ultraviolet rays with energy 134,000 erg/sec/cm^2 at wavelengths from 405 to 289 mμ. Blood sugar levels were assayed photocolorimetrically. Hyperglycemia was elicited by intragastric administration of 1.5 g glucose per kg body weight, and hypoglycemia by injecting 2 units of insulin per kg body weight intravenously. Single irradiations of the skin in rabbits with high doses of uv rays caused a slight rise in the blood sugar levels with a maximum of 60 minutes after the irradiation unless glucose was not administered. After repeated daily irradiation the blood sugar levels in the rabbits were elevated only slightly, especially after 10 days. Repeated irradiation altered the blood sugar regulating mechanisms in such a way that the postinsulin hypoglycemia was less pronounced and of shorter duration. It was assumed, although with caution, that irradiation with high doses of uv rays increases the tone of the sympathetic part of the nervous system or increases the activity of the adrenals. (P.C.H.)

8805 STRUCTURE OF THE CHLOROPHYLL-LESS MUTANT OF EUGLENA CELL BY NEUTRON IRRADIATION. Saburo Matsuoka (Gifu Prefectural Medical School, Japan). Acta Scholae Med. Gifu, 10: 95-9(Mar. 31, 1963).

Morphological changes on the structure of chlorophyll-less mutant (CLM) of neutron irradiated Euglena cells were compared with the normal cell. More deforming chloroplasts by irradiation were observed in the cell than in chlorosis. The chlorophyll-less mutant cell has either a trace of chloroplast or none at all. The cells were white in the incubation medium under light. An average size of chlorophyll-less mutants was 45 μ long by 11 μ wide, and that of the normal cells was 52 μ long by 12 μ wide. Chlorophyll-less mutant had considerably fewer number of cytoplasmic granules than the normal cell. (P.C.H.)

8806 FLASHBLINDNESS: A PROBLEM OF ADAPTATION. J. H. Hill and Gloria T. Chisum (Naval Air Development Center, Johnsville, Penna.). Aerospace Med., 35: 877-9(Sept. 1964).

Nuclear weapons cause light flashes capable of producing casualties, the intensity of the flash being sufficient to affect the eyes and visual processes to the extent that retinal burns, flashblindness, or both may occur. Flashblindness, the temporary reduction in visual sensitivity due to exposure to a high intensity flash, is considered here. Since flashblindness is a potential problem to pilots of modern high performance aircraft, some possible solutions toward avoiding it are presented and evaluated. A brief description of the visual processes affected is given, and the relation of light adaptation and dark adaptation of the eye to the changing lighting conditions and the recovery of sensitivity to a functional level are discussed. A pilot flying at night and using minimum instrument lighting when exposed to the flash from the detonation of a nuclear weapon, would be functionally blind even under the light conditions of a moonlit night for five min or possibly longer. The pilot's adaptation level would be shifted to a point which would temporarily prevent him from perceiving his instruments. It is essential then to maintain the eye at the level of adaptation suited to the lighting conditions which existed prior to the weapon flash or change the lighting conditions to suit the level of adaptation brought about by the weapon flash. The suitability of fixed density goggles as a protective system is examined and the results of the simulation of protective devices with closing times of 33 μsec, 165 μsec, and 9.8 msec are reviewed. It is shown that as the integrated luminance increases, the recovery time to a given light level of the display also increases, but the increase is inversely proportional to the light level of a display (e.g., instrument panel). That is, for a constant exposure an increase in the display luminance reduces the recovery time. Furthermore, the recovery time for the 165-μsec closing time is only about one-half of that for the 9.8 msec closing time. The shorter the closing time an eye protective system has, the better it is at preserving visual sensitivity. The retinal independence of the two eyes suggests the use of one eye with its possible exposure to a weapon flash while the other eye is covered and kept safely in reserve. A study of the use of an eye patch as a flash protection device showed that an eye thus covered during a flash can perceive a target in a significantly shorter time than an uncovered eye. The perception time for the covered eye was not as short as would be predicted, however, which suggests the possibility of some centrally mediated interference due to the afterimage produced by the stimulation of the uncovered eye. (BBB)

8807 APPLICATION OF THE 22.5 Mev DEUTERON MICROBEAM TO THE STUDY OF MORPHOGENETIC PROBLEMS WITHIN THE SHOOT APEX OF OSMUNDA CLAYTONIANA. C. C. Kuehnert and J. P. Miksche (Brookhaven National Lab., Upton, N. Y.). Am. J. Botany, 51: 743-7(Aug. 1964).

Excised shoot apices of Osmunda claytoniana were grown under controlled sterile conditions. Histological examination of the normal shoot apex shows that it is comprised of: a promeristem, which possesses one or more apical initiating cells at its center; a prestelar tissue consisting of an incipient vascular tissue which flanks the pith-mother-cell zone; the pith-mother-cell zone gives rise to the pith rib meristem and subsequently to the fundamental parenchyma of the pith; and the fundamental parenchyma of the cortex and the fundamental parenchyma of the dermal system both arising from flank cells of the promeristem. Apical initial cells of meristems irradiated with a 127,000 rad acute exposure of a deuteron beam having a diameter of 25μ, histologically examined at 7-day intervals for a 12-week period, as early as 3 weeks' postirradiation, showed the apical initiating cell(s) together with certain of the cells of the pith-mother-cell zone to be destroyed. A wound response develops peripherally to the destroyed initials. In addition, an isolated, organized growth center is observed to develop from normal promeristem cells. Incipient vascular tissue and a new pith-mother-cell zone are also observed to develop in association with the new center of growth. Implications of the role of the interrelationships between apical initiating cell(s) and other cells of the meristem and the role they may play in maintenance of meristematic integrity within the shoot meristem are discussed. (auth)

8808 SKIN AND GONADAL DOSAGES DURING INVESTIGATIVE RADIOGRAPHY. Stanley M. Garn, Frederic N. Silverman, and Ann A. Davis (Fels Research Inst., Yellow Springs, Ohio). Am. J. Phys. Anthropol., 21: 561-8(Dec. 1963).

Data are reported on skin and gonadal doses incurred in the course of diagnostic radiography, employing presently known methods of reducing radiation dosages, and shields and other protective devices specifically designed to limit already small skin dosages of radiation. Investigative radiography is done to acquire information on growth and development in normal humans, information on body composition, changes in bone mineral, and the genetics of dentofacial development. This investigation is based on 729 dosimeter readings on normal subjects ranging from three through 75 yr of age. Skin doses varied from less than 5 mr to over 90 mr, according to the radiographic techniques used. The lowest skin doses were characteristic of the younger subjects, subjects with small tissue thickness, and for areas of limited tissue density such as the chest. The highest skin doses were recorded in older subjects and those of heavier build, and for areas of greater tissue density. The nonscreen film technique resulted in skin dosages 15 times as high as the comparable techniques involving fast film and intensifying screens. Gonadal doses with radiation-limiting portable shields gave dosimeter values for individual radiographs too low to provide meaningful readings. Values obtained for a set of radiographs taken at one examination and grouped according to subject age gave dosages in the gonadal region averaging low 0.25 mR. In general, gonadal doses increased with advancing age, since higher kilovoltages were employed for larger subjects. Radiation-sparing and radiation-limiting measures made it possible to reduce skin and gonadal doses to minimum values. Fast film, forced development, maximum coning-down, and optimum filtration thus are essential for investigative radiography. The value of fixed or movable grids in head or extremity radiographs for investigative purposes becomes questionable in view of the greater skin and gonadal doses. The nonscreen film technique, with its greatly increased skin dosage, is not to be recommended unless sensitometric considerations preclude the use of conventional film-screen combinations. It is concluded that the gonadal doses, which averaged under 0.25 mR for young adult subjects, are less than the irreducible daily background dose at sea level. Thus radiographs taken for investigative purposes provide less than 1/1000 of the total irreducible background dosage during the reproductive years. (BBB)

8809 ACUTE AND LONG-TERM EFFECTS OF X-IRRADIATION ON SKELETAL GROWTH IN THE RAT. Richard D. Phillips and Donald J. Kimeldorf (Naval Radiological Defense Lab., San Francisco, Calif.). Am. J. Physiol., 207: 1447-51(Dec. 1964).

The early and long-term effects of x irradiation on skeletal growth were investigated with respect to the age at exposure. Rats exposed at a juvenile age (37 days) to a sublethal dose (430 Rad) exhibited a retardation in femur, tibia, and tail growth within 14 days after exposure. The maximal deficit was attained within 30 days after exposure and remained approximately constant for the next 300 days. In animals that were exposed to x rays as young adults (101 days of age), femur and tibia length did not differ from those of controls for the first 2 months after exposure. However, there was a deficit in femur and tibia length in these animals at the end of life span. The magnitude of the bone length reduction at the end of life span was dose dependent. The two major differences in response between the two age groups were the time course of the radiation effect on growth and the magnitude of the deficit. The reduction in bone length occurred faster and was greater in the younger irradiated group. (auth)

8810 BIOPHYSICAL CONSIDERATIONS CONCERNING THE EXISTENCE OF A THRESHOLD DOSE FOR RADIATION EFFECTS. Harald H. Rossi (Columbia Univ., New York). Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 196-9(Jan. 1965).

The existence of a threshold dose for the killing of the mammalian cell by low LET (linear energy transfer) radiation such as conventional x and gamma rays is discussed. Because of overlap of ΔZ spectra, it appears that for low LET radiation there must also be a finite slope of the dose effect curve near the origin no matter what the pertinent parameters may turn out to be. Since the energy required for injury is probably less, and certainly not much more than that required for killing, these considerations should also apply to nonlethal damage, which is far more important than cell death in low level chronic exposure. (P.C.H.)

8811 ACUTE PATHOLOGIC ALTERATIONS IN X-IRRADIATED PRIMATE FETUSES. Luciano Ozzello and Roberts Rugh (Columbia Univ., New York). Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 209-21(Jan. 1965).

Pathologic alterations were studied in various organs and tissues of monkey fetuses after they had received x irradiation in utero (200 R to 400 R) during the last third of pregnancy. Major alterations observed were: fatty degeneration of liver cells during the first 2 days after exposure, followed by complete recovery; necrosis of epithelial cells in the nephrogenic zone of the kidney leading to premature disappearance of this zone; severe necrosis of lymphocytes in the thymus and depletion of lymphocytes in spleen and lymph nodes; marked depression of extramedullary hemopoiesis in liver and spleen, sometimes followed by partial recovery; and marked depression of mitotic activity. (P.C.H.)

8812 NEW OBSERVATIONS CONCERNING ROENTGEN SENSITIVITY OF PIGMENT CELLS IN YOUNG AXOLOTLS (SIREDON MEXICANUM). V. V. Brunst (Roswell Park Memorial Inst., Buffalo). Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 222-37(Jan. 1965).

The anterior portion of the heads in 3 groups of 77 young axolotls (24 days after hatching) was irradiated with 500, 1,500 and 3,000 R, respectively; in 3 other groups (78 animals of the same age), the tails were irradiated on the same day with the same doses; 1 group of 20 animals from the same spawning served as untreated controls. In the irradiated tails, the number of melanophores was reduced. Most of the melanophores were abnormal. They had either a globular or an irregular form without any processes. The long multibranched outgrowths of melanophores could be seen in only a few areas. In some regions of irradiated tails, the melanophores were either absent or uniformly globular. In rare instances globular melanophores of giant size could be observed. Globular melanophores were also noted in the irradiated head, but they were comparatively rare and usually isolated between normal melanophores. In some regions of the irradiated head, all the melanophores in all tissues were normal. A reduction in the number of the melanophores in the tail can be explained by the activity of macrophages, which phagocytize irradiated melanophores. The results showed that a considerable difference in melanophore radiosensitivity exists in tail and head regions. The resistance to radiation of the pigment cells of the choroid of the eye and the stimulation by irradiation of the development of pigment cells in the liver and cornea of the axolotl are discussed. (P.C.H.)

8813 EVALUATION OF THE IONIZING RADIATION DOSE ABSORBED BY THE GONADS IN DIAGNOSTIC PRO-

CEDURES AND TECHNIQUES INTENDED TO REDUCE IT. Ennio Zanetti, Luigi Tosca, Ulisse Fasola, G. Franco Rossi, Sergio Gandini, and Aldo Mondina (Università, Milan). Ann. Ostet. Ginecol., 84: 535-72(July 1962). (In Italian)

It is known that the dose of the natural radiation to which humans are exposed is ~0.1 rem/yr and 3 rem in 30 yr. Any increment in the dose of ionizing radiation may interfere with human biology. The first source considered is the radiation from fallout which increases the gonad doses 3 to 4 mrem a yr. This contribution from recent thermonuclear explosions mainly results from the ^{90}Sr, ^{137}Cs, and ^{14}C. Also considered is the radiation dose absorbed by the gonads when x rays are used on other parts of the body in diagnostic examinations, which gives a dose of ~150 mr/yr (equal to 4.5 r over 30 yr) being received by the gonads. The exact genetic damage expected from such doses is hard to determine because of various factors not yet delineated. To reduce the dose to the reproductive organs to a minimum, the following precautions are suggested: the use of an image intensifier instead of conventional fluoroscopic screens, which will reduce the primary necessary radiation dose to 1/10; a very accurate limitation of radiation beam; the use of hard rays and adequate filters; application, if possible, of protective shields for the gonads; use of fast film; use of accurate timers for film exposure and optimal development techniques; and rigid rules allowing the use of radiologic machines only by specially trained personnel. These precautions, if consistently applied, should reduce the physical dose to the gonads and the consequent biologic damage. (BBB)

8814 COMPARISON BETWEEN THE ACTION OF X RAYS AND DETOXIFIED VENOM FROM THE SNAKE *NAJA NAJA* ON ADRENAL CORTICAL MITOSES IN THE MOUSE. R. M. May, J. Guimard, and J. P. Denefle (Faculte des Sciences, Paris). Arch. Anat. Microscop. Morphol. Exptl., 53: 57-68(Jan.-Mar. 1964). (In French)

A study was performed to compare the effect on the adrenal cortex of 900-R doses of x rays applied ventrally to mice with that of three doses (1000 μg/g each) of detoxified venom of *N. naja* injected intraperitoneally. Results of cytologic examination showed no significant modification of the number of prophase nuclei in the adrenocortical zona glomerulosa of irradiated animals, an absence of abnormal prophases, and no significant difference between the number of adrenal mitoses from animals sacrificed five or ten days post-irradiation. The effect of the venom on the other hand was a significant decrease in the number of zona glomerulosa prophases. This inhibitory action of the venom was of the same intensity five or ten days following its application, which corroborates an *in vitro* effect described previously by others, and was not modified by whole-body irradiation immediately following the injection. It was concluded that the adrenal cortex shows only a weak radiation sensitivity due possibly in part to its deep position in the mammalian organism. (TCO)

8815 RADIATION-INDUCED CARCINOMA OF THE MASTOID. David D. Beal, John R. Lindsay, and Paul H. Ward (Univ. of Chicago). Arch. Otolaryngol., 81: 9-16(Jan. 1965).

During recent years over 300 patients with radium poisoning were followed and eight developed carcinoma of the mastoid area. Six of these patients died of the tumors, and the temporal bones in two cases were removed and studied histologically. The pathological findings are presented and illustrated with photomicrographs. The etiology of the neoplasms was felt to be the radiation effect of the radioactive particles released during the breakdown of the radium deposited in the bones, with closely applied epithelium. (auth)

8816 X-IRRADIATION STERILIZATION OF THE PREMATURE FEMALE MOUSE. R. Rugh and M. Wohlfromm (Columbia Univ., New York). Atompraxis, 10: 511-18(Dec. 1964).

Female CF, Swiss white mice were x irradiated at birth, 1, 2, and 3 weeks, and 1 and 2 months of age to either 30 or 100 r and were tested by continuous exposure to mature males of the same strain, beginning at two months of age and terminating at 1 year of age in an effort to determine whether such exposures would render the females sterile. The newborn mouse was 3 times as radioresistant to x rays as the same mouse at 1 month of age, in terms of lifetime reproductive activity. Ovarian sterilization can be confused with general body debility but exposure to 100 r was tolerated much better by the soma than by the germ-plasm. (auth)

8817 SOME BIOLOGICAL EFFECTS OF IONIZING RADIATION. I. EFFECT ON THE RIBONUCLEIC ACID OF THE REGENERATING RAT LIVER. G. Sala and A. Raffi (Università, Naples). Atti Accad. Med. Lombarda, 18: 437-8(1963).

Exposure of regenerating rat liver to x rays caused no structural change in the RNA. (Excerpta Med., Sect. 23, 1: (Nov. 1964))

8818 BIOLOGICAL EFFECT OF IONIZING RADIATION: DEMONSTRATION OF INCREASED FRAGILITY OF THE CYTOPLASMIC GRANULES. G. Sala and A. Raffi (Università, Naples). Atti Accad. Med. Lombarda, 18: 439-44(1963).

X-ray exposure was found to cause release of DNA-ase and acid phosphatase from mitochondria, as well as ribosomes. (Excerpta Med., Sect. 23, 1: (Nov. 1964))

8819 SOME BIOLOGICAL EFFECTS OF IONIZING RADIATION. II. EFFECT ON RNA OF THYMOCYTES. G. Sala and A. Raffi (Università, Naples). Atti Accad. Med. Lombarda, 18: 444-6(1963).

Exposure of rat thymus to x rays caused increased lability of the tissue RNA, resulting from a structural alteration in the RNA (or its protein linkage) and an increase in RNase activity. (Excerpta Med., Sect. 23, 1: (Nov. 1964))

8820 FURTHER EXPERIMENTAL OBSERVATIONS ON THE CHANGES IN THE CARDIAC VALVES CAUSED BY GAMMA RAYS (RADIATION VALVULITIS). R. Scalabrino and L. Rossi (Ospedale Fatebenefratelli, Milan and Università, Milan). Atti. Soc. Ital. Cardiol., 22: 435-6(1962). (In Italian)

As a follow-up of previous experiments on the endocarditis developing in the hearts of rabbits treated with ^{60}Co radiation, further studies were made on the relation between valvular lesions and γ-ray doses, as well as the correlation between the observed pathologic changes and the time postirradiation. Radiation-induced valvulitis shows an inflammatory leukocytic infiltration consisting mostly of polymorphonuclear cells, with some eosinophils, and slight histiocyte activation and marked subendothelial edema; however, the endothelium was not disrupted. It appeared that the inflammatory activity was concentrated more in the valvular area rather than in the parietal endocardium, which also showed some subendothelial inflammation. Valvulitis was found to be present six hr after the administration of 750 R; in animals treated with the same dose and sacrificed after three to 16 days the valves appeared undamaged. Other animals submitted to 1500, 3000, and 12,000 R, showed the same valvulitis after six to 24 hr, but valvular lesions had disappeared after six to 16 days. The periodic acid-Schiff reaction showed that the content of mucopolysaccharides in the area adjacent to the valves had not been altered. While the effect of radiation on other anatomic and histologic components of the heart is not considered here, the valvulitis from γ irradiation appeared very early, reaching an acute pathologic state, but regressing after one to three days without any lasting effects even in animals treated with very large doses. These observations agree with those made on humans and animals who died from two to six weeks after the explosions of nuclear weapons at Hiroshima and Bikini, respectively. It is suggested that a mechanism involving autoantibodies is responsible for the pathogenesis of this inflammatory process. These observations have clinical significance for high-energy radiation treatment in the mediastinal fields. (BBB)

8821 CYTOPLASMIC BUDDING OF HUMAN LYMPHOCYTES DUE TO IONIZING RADIATION. D. O. Shiels

(Univ. of Melbourne). Australasian Ann. Med., 13: 247-50 (Aug. 1964).

The results are presented of observations during the past eight years or so on a large number of humans exposed in their work to low doses of ionizing radiation, on a smaller number accidentally exposed to higher short-term doses, and on a considerable number of humans not exposed to more than the ordinary background radiation. The results indicated highly significant differences between the results for exposed and unexposed groups for the small, and large-plus-small, lymphocytes, and significant differences for the large lymphocytes. Radiation caused statistically significant increases in the percentage of lymphocytes, both large and small, which exhibited cytoplasmic budding in Leishman-stained air-dried blood films of humans exposed to low doses. In subjects exposed to not more than 10 R, over 50% of small lymphocytes exhibited this phenomenon. (P.C.H.)

8822 THE SENSITIVITY OF THE GALACTOSE OPERON OF E. COLI TO UV-LIGHT. Peter Starlinger and Eckehart Koelsch (Universität, Cologne). Biochem. Biophys. Res. Commun., 17: 508-11(Nov. 30, 1964).

The uv radiosensitivity of the galactose operon of E. coli was investigated. The cellular capacity of E. coli to synthesize the three galactose enzymes, epimerase, transferase, and kinase, was inactivated at different rates. Under the experimental conditions used, the final slopes of the bacterial survival curves differed by a factor of 75. Since the capacity for the synthesis of the single enzymes was affected to different degrees, it is assumed that direct damage is, at least partially, involved. (P.C.H.)

8823 POST-IRRADIATION DEGRADATION OF DNA FOLLOWING EXPOSURE OF UV-SENSITIVE AND RESISTANT BACTERIA TO X-RAYS. Peter T. Emmerson and Paul Howard-Flanders (Yale Univ., New Haven). Biochem. Biophys. Res. Commun., 18: 24-9(Jan. 4, 1965).

The relationship between radioinduced DNA degradation and radiation dose was studied in x-irradiated cultures of E. coli. It was concluded that in E. coli K-12, the capacity to degrade DNA after x irradiation is not affected by a mutation at any one of the genetic loci uvrA, uvrB or uvrC, which are known to control thymine dimer excision. At low doses it was found that several thousand nucleotides are released per estimated radiation product formed in the DNA. (H.M.G.)

8824 X-RAY AND ULTRAVIOLET SENSITIVITY OF SYNCHRONIZED CHINESE HAMSTER CELLS AT VARIOUS STAGES OF THE CELL CYCLE. W. K. Sinclair and R. A. Morton (Argonne National Lab., Ill.). Biophys. J., 5: 1-25 (Jan. 1965).

Populations of Chinese hamster cells, synchronized by selecting for cells at or close to division, were exposed to 250 kvp x rays and to ultraviolet light at different stages of the cell cycle and colony-forming ability examined thereafter. These cells were found to be most resistant to x rays during the latter part of the DNA synthetic period (S) and to be about equally sensitive before (G_1) and after (G_2) this period. Multitarget type curves of the same slope ($D_0 \sim 200$ Rad) only approximately fitted the survival data at different stages in the cycle. The changes in response were primarily due to variations in the shoulders (or extrapolation numbers) of the curves however. The response to ultraviolet light differed from that to x rays. Resistance was greatest in G_2 and changes in both shoulder and slope of the survival curves occurred throughout the cell cycle. The x ray and ultraviolet responses for component stages of the cell cycle were respectively compounded into expected survival data for a log phase asynchronous population of hamster cells and found to agree well with direct experiment. (auth)

8825 EVIDENCE FOR TWO MECHANISMS OF PHOTOREACTIVATION IN ESCHERICHIA COLI B. John Jagger and R. S. Stafford (Oak Ridge National Lab., Tenn.). Biophys. J., 5: 75-88(Jan. 1965).

Escherichia coli B phr$^-$, which is not photoreactivable under certain conditions, has been shown to exhibit photoreactivation of killing in the logarithmic growth phase at 3341 A. Dependence of the reaction upon wave-length, dose, and dose rate of the reactivating radiation, as well as upon temperature during reactivation treatment, is very similar to that of photoprotection. It was concluded that this photoreactivation is similar in mechanism to photoproduction, believed to be an indirect repair process, the initial step of which is non-enzymatic and leads to a growth-division delay. The present phenomenon is called indirect photoreactivation. Similar studies suggest that indirect photoreactivation of killing occurs also in the parent strain, E. coli B (Harm). It has often been supposed that all photoreactivation results from a photoenzymatic reaction similar to that found to operate in vitro on transforming DNA. Data obtained provide the first evidence for two distinct types of photoreactivation of cell killing, one of which appears not to involve photoenzymes. The experiments also show that photoprotection results from intracellular events that can be induced by treatment after, as well as before, far ultraviolet irradiation. (auth)

8826 HISTOLOGICAL STUDIES OF THE RADIOSENSITIVITY OF LENS EPITHELIUM. L. Scullica (Università, Rome). Boll. Oculist., 41: 508-13(1962). (In Italian)

The pathogenic relation between epithelium alterations and microscopic lesions of the lens after local doses of x rays was studied. The right lens of rats was exposed to a 1000 R dose of x rays. The eye was enucleated and fixed in Carnoy solution and the isolated lens stained by the Feulgen method. A red demarcation line was visible at the border of the epithelium marking the equatorial zone. In the first hours postirradiation and earliest lesions appeared in the postequatorial zone (karyorrhexis, karyolysis, pyknosis), indicating the greater radiosensitivity of the differentiating cells. In the equatorial and pre-equatorial zone, mitosis was inhibited after two hr and changes in the cells appeared. After 24 hr karyokinesis was noted along with atypical cells with very enlarged nuclei in which the chromatin did not stain well but showed strongly Feulgen-positive granules (Type A cell). After two days a different kind of atypical cell was noted with hyperchromic nucleus and irregularly distributed chromatin (Type B cell) in the equatorial, pre-equatorial, and central zones, representing a regressive phase in various stages. After five days the mitoses of the irradiated lens epithelium reached the value of the control. From the 14th day postirradiation giant cells were noted together with cells with large nuclei but homogeneous chromatin (Type C cells). All these changes are effects of the ionizing radiation leading finally to cellular rarefication extending into the equatorial zone. Evidently the differentiating postequatorial zone and the germinative equatorial zone are more sensitive to radiation than the central zone. This regenerative zone of the epithelium shows relative resistance to radiation. (BBB)

8827 CHANGES IN BEHAVIOR, REFLEXES, AND EQUILIBRIUM IN THE RAT BRAIN IRRADIATED WITH COBALT-60 GAMMA RAYS. M. L. Tognacca, G. Merlo, and C. Pisani (Ospedale Maggiore, Novara, Italy). Boll. Soc. Ital. Biol. Sper., 39: 245-7(Mar. 15, 1963). (In Italian)

Sixty adult Long-Evans rats on a standard diet were used in this investigation. Ten animals served as a control group and the remaining 50 experimental animals received a single radiation dose of 2000 rad (calculated for the cerebral cortex) over the entire brain area. Irradiation was performed with ^{60}Co γ rays (1.17 to 1.34 Mev) over a field of 3 × 3 cm. The rats' behavior was tested in terms of spontaneous motor activity and reaction to outside and proprioceptive stimuli, in particular tactile stimulation of the nostrils, a test of their ability to reascend if suspended at the tail, and one of muscular tonus. Their equilibrium was tested on a rotating bar. Their vestibular reactivity was examined by fixed plane rotation and labyrinth postural reflexes. In the first to second day after irradiation the animals manifested a state of general torpor, and hypertonia of the dorsal muscles. Motility and motor activity were reduced. At the third to fourth day equilibrium and orientation disturbances commenced. Disturbances of the autonomic nervous system, such as profuse conjunctival and rhinopharyngeal secretion, temperature fluctuations, respiratory disturbances, and diffuse edema were noted in the irradiated areas from the fifth day to the eighth or ninth day in 40% of the irradiated animals, and gradually became more accentuated. The torpor became more accentuated as well as the discoordination and paretic symptomatology, traceable to the posterior motor area, and general hyporeflex activity. Upon optic and acoustic stimuli the reflex activity was reduced. Labyrinth postural reflexes and nystagmus were practically absent. In the eighth to ninth day maximum mortality reaching 35% in the treated animals was observed. The dying animals manifested diarrhea, severe hypothermia, very low respiratory rate, and heartbeat, and profuse rhinopharyngeal and conjunctival secretion. Post-mortem examination revealed: brain hyperemia with edema; exudative inflammation (in some cases purulent) of the rhinopharyngeal mucous membrane; hyperemic viscera, intestine and stomach bloated with air, hemorrhagic petechiae of the small intestinal walls. Animals surviving 30 days postirradiation showed complete regression of the neurological disturbances, and nine to ten months later showed complete functional equilibrium as in the controls. This investigation confirmed that permanent damage to the Purkinje's and granule cells does not prevent survival or later return to normalcy in behavior. It is concluded that alteration of the neurons by radiation does not sufficiently influence the organization of neural tissue to a degree incompatible with organic function. (BBB)

8828 THE DETERMINATION OF BINUCLEATE LYMPHOCYTES IN BODY EXPOSURE TO SMALL DOSES OF IONISING RADIATION. L. Blažeková. Bratislav. Lekarske Listy, 43-I: 404-8(Apr. 1963).

The possibility of using hematological changes, and particularly binucleate lymphocytes, as biological indicators of radiation injury is discussed. Persons exposed to repeated small doses of ionizing radiation over an average of three years in the course of their work (on nuclear reactors, and checking the quality of welds by using x rays) revealed a statistically significant increase in bilobed nuclei at doses of 0.017 to 0.079R per week, taking a three months average. A special blood cell scanner is also described. (Occupational Safety Health Abstr., 2: No. 5, 1964)

8829 PHYSIOLOGIC FACTORS DETERMINING IN THE FORMATION OF MELANOTIC TUMORS IN DROSOPHILA (D. MELANOGASTER). INFLUENCE OF HEAT AND IRRADIATION. S. Ghelelovitch (Université, Paris). Bull. Assoc. Franc. Etude Cancer, 50: 399-411(July-Sept. 1963). (In French)

It has been shown that irradiation of Drosophila larvae increases somatic cell sensitivity towards the effect of a transforming principle or of a tumor-inducing factor. It is also known that the application of heat has an effect on spontaneous tumorigenesis in Drosophila, but its role has not been elucidated. In this study the effects of heating and irradiation were combined to investigate the process of tumor development in this insect. In the various experiments x irradiation (600 to 3000 R) either preceded or followed the application of heat to the larvae. Results showed that thermal treatment in all cases significantly decreased the number of pupae presenting tumors, but had no effect on the multiplicity of tumors appearing in those insects in which heat failed to have an effect. Heat also did not modify the size of the developed tumors, which were much larger in irradiated animals by comparison with the nonirradiated. Sensitivity to heat increased in both irradiated and nonirradiated larvae with increased age. Heat had less effect on irradiated than nonirradiated larvae; this was clearly demonstrated when heat was applied from the 24th to the 48th hour of larval life. Tumor formation was inhibited in 50% of nonirradiated larvae, but larvae receiving 600 R at age 24 hr were not affected. These results showed the necessity for distinguishing at least two stages in Drosophila tumor development. Three factors operate in the manifestation of this phenomenon: cellular sensitivity, which can be increased by irradiation; tumorigenic stimulus, the effectiveness of which depends on genetic constitution; and the promoting factor, which can be inhibited by heat. Heat may completely suppress the probability of tumor development but cannot modify the process quantitatively. (BBB)

8830 DYNAMICS OF THE WHITE BLOOD REACTION TO IRRADIATION. I. K. Petrovich and Yu. I. Moskalev. Bull. Exptl. Biol. Med. (USSR) (English Transl.), 57: 153-7 (Feb. 1964). Translated from Byul. Eksperim. Biol. i Med., 57: 33-7(Feb. 1964).

A study was made of the early reactions of the lymphoid and myeloid hemopoiesis following a wide range of x-ray doses (from 50 to 12,000 R – a total of 8 doses) in 70 rats. As a result of repeated investigations (12) of the peripheral blood composition (within a 24-hour period) it was established, that the changes of the lymphocyte and neutrophil count differ and it was impossible to assess the changes occurring in the white blood by the total number of leukocytes. The dose-effect curve for lymphocytes and neutrophils differed by the rate of the process and by the shape of the curve these indexes show a significant change in time following irradiation. The mechanism of the mentioned changes requires special study. (auth)

8831 EXPERIMENTAL OVARIAN TUMORS IN RATS. E. A. Ird (Inst. of Experimental and Clinical Oncology, Moscow). Bull. Exptl. Biol. Med. (USSR) (English Transl.), 57: 337-9(Mar. 1964). Translated from Byul. Eksperim. Biol. i Med., 57: 89-91(Mar. 1964).

Estrogen-active tumors of the ovaries, differing in histological structure, were obtained in rats as a result of depression of ovarian function by x irradiation, by transplantation of the ovary into the muscles of spayed female, or by subtotal ovariectomy. In rats with pre-tumor changes there was a rise in the gonadotropic activity of the hypophysis, while animals with developed tumors presented a reduction of hypophyseal activity. Induced tumors were successfully transplanted to spayed females with retention of estrogenic activity following transplantation. (auth)

8832 DURATION OF MITOSIS IN THE CORNEAL EPITHELIUM OF FASTING ANIMALS. O. T. Movchan (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Bull. Exptl. Biol. Med. (USSR) (English Transl.), 57: 90-3(Jan. 1965). Translated from Byul. Eksperim. Biol. i Med., 57: 95-8(Jan. 1964).

X irradiation was used to study the duration of mitosis in the corneal epithelium of albino rats after 2, 3, and 7 days of starvation. As established, after 2 and 3 days of starvation there was no difference in the rate or number of mitoses in starving and control animals. It was concluded from the data that the period of interkinesis is the same in experimental and control animals. In rats starving for 7 days the rate of mitosis proved to be somewhat increased; however, the main cause of reduction of the number of dividing cells was the increase of the length of interkinesis. (auth)

8833 POST-MORTEM FINDINGS IN MICE DYING AFTER SUBLETHAL IRRADIATION AND HOMOLOGOUS SPLEEN INJECTION. M. Boranic, I. Hrsak, and V. Stankovic (Institut "Rudjer Boškovic", Zagreb). Bull. Sci., Conseil Acad. RPF Yougoslavie, 9: 69-70(June 1964).

Post-mortem examinations were performed on mice that died after irradiation with 500-550 R and/or injection of 15-30 × 10^6 spleen cells from C57L mice. Animals irradiated only or afterwards injected with suspending solution survival as a rule. On the other hand, mice that received foreign splenocytes became seriously ill during the second week. They refused food and water, emaciated and developed a hunched posture with ruffled fur. Two-thirds of the mice suffered from diarrhea, which in 20% of the cases was blood-tinged or even tarlike (melaena). Autopsy revealed widespread changes in the lymphatic and hematopoietic system, in the lungs, bowel, and liver. (P.C.H.)

8834 LUNG METASTASES OF TARRED MICE CAUSED BY RADIOACTIVE IRRADIATION. A. Kosir (Inst.

of Histology and Embryology, Ljubljana, Yugoslavia). Bull. Sci., Conseil Acad. RPF Yougoslavie, 9: 72(June 1964).

Mice (P-generation) were wholly irradiated with a dose of 10 R and then mated, their descendants (F_1-generation) were irradiated with the same dose, so were the F_2-F_9 generations, which meant 10 generations altogether. The mice of F_9-generation were treated with biologically active (carcinogenic) tar. No differences regarding skin carcinoma were found. But in five cases the irradiated mice developed lung metastases of skin carcinoma while the controls did not. (P.C.H.)

8835 THE LEUKEMIAS. Nicholas L. Petrakis (Univ. of California, San Francisco). Calif. Med., 101: 33-41 (July 1964).

A review with 60 references of etiology and therapy of leukemia, including discussion of possible role of radiation, their causation, and application in treatment. (BBB)

8836 SOME PHYSIOLOGICAL ASPECTS OF MUTANTS OF *ESCHERICHIA COLI* RESISTANT TO GAMMA IRRADIATION. Edmund S. Idziak and F. S. Thatcher (Dept. of National Health and Welfare, Ottawa). Can. J. Microbiol., 10: 683-97(Oct. 1964).

The formation of elongated or filamentous cells in normally short-celled bacterial cultures may occur as a result of natural ageing of the cells, the presence or absence of certain elements or irradiation. When the factors responsible for the elongation are corrected, the cells usually revert to their previous size or die. However, when γ irradiation was used to obtain filamentous forms of *E. coli*, permanent changes were transferred from progeny to progeny in the absence of irradiation. These γ-irradiation-resistant mutants of *E. coli* were found to be indole negative. They did not produce mucoid or slime material in Endo's agar. A marked variation was noted in the rates of growth of the resistant mutants under shaking and stationary conditions of culture. The mode and rate of utilization of specific carbohydrate substrates by a strain highly resistant to γ irradiation (12 γ) differed from that of the parent (P) strain. The 12 γ resting cell suspensions exhibited no respiration on lactose, but substantial activity on glucose and succinic acid. It appeared that the tryptophan readily penetrates into 12 γ cells, but that its mode of utilization is altered, presumably by the inhibition of an enzyme involved in its metabolism. It is suggested that the permease systems have been altered. The fact that 12 γ cells from shaken cultures respire slightly on lactose supports this view; permeability is very often altered by the physical forces involved during the shaking period. The permanent inability of the 12 γ cells to produce mucoid or slime material is suggestive of alteration in the genetic material within the cells, viz. DNA. The amounts of DNA and RNA per mg dry weight and per unit cell volume, respectively, were different in the 12 γ and P cells. The DNA content per normal and elongated cell was quantitatively the same. Other evidence from *in vitro* and *in vivo* experiments suggest that γ irradiation alters the molecular structure of the DNA and RNA in the cells. Whether the change involved is one of substantial reorganization of the molecule or one of simple cross-linkage, affecting the permeability of internal barriers of the cells, is being investigated. (BBB)

8837 THE USE OF Cr^{51} AS A CRITERION OF THYMOCYTE REGENERATION AFTER WHOLE BODY X-IRRADIATION. P. V. Vittorio, P. J. Baker, and S. Dziubalo-Blehm (Defence Chemical Biological and Radiation Labs., (Ottawa). Can. J. Physiol. Pharmacol., 43: 19-27(Jan. 1965).

The uptake of ^{51}Cr chromate by thymocytes *in vitro* after whole-body x irradiation can be used as a sensitive quantitative criterion not only for the evaluation of early radiation damage to these cells but also as a measure of later regeneration. Development of the radiation lesion is characterized by a reduction in the *in vitro* uptake of ^{51}Cr and the later regeneration of new cells by an increase in ^{51}Cr uptake which is probably due to increased uptake of ^{51}Cr by the young newly formed cells in the damaged tissue which is proliferating in an attempt to repair the damage. The return of the ^{51}Cr uptake to normal is an indication of the time required for the cell population (ratio of young to older cells) to return to normal. By this technique the effect of different doses of x irradiation on the regeneration of thymocytes was demonstrated. Treatment with AET before whole-body x irradiation (400 R) indicated that less regeneration was necessary but the recovery time remained unchanged. Age differences produced a change in the extent of repair or regeneration but no change in recovery time. Spermatozoa showed evidence of early damage after whole-body x irradiation. This damage increased with time with no evidence of increased regeneration or repair. (auth)

8838 THE INFLUENCE OF LEUROCRISTINE ON TRANSPLANTATION IMMUNITY. C. Radzikowski, J. P. Glynn, and A. Goldin (Polish Academy of Sciences, Danzig). Cancer Chemotherapy Rept., 32: 15-18(Oct. 1963).

A comparison was made of the ability of leurocristine and x radiation to suppress transplantation immunity in adult C57BL/6 (H-2^b) and CAF_1 (BALB/c X A/LN) (H-2^d X H-2^a) male mice. Their ability to suppress host defense mechanisms in mice was studied employing growth of Leukemia L1210 and skin grafts in allogenic mice as indicators of suppression of host immune mechanisms. Local tumors failed to develop in normal C57BL/6 mice at any inoculum concentration. In contrast, all isologous animals inoculated with L1210 suspensions developed progressive local tumors. Leurocristine pretreatment resulted in local tumor growth in 22 of 28, 8 of 25, and 1 of 22 animals at the 10, 1.0, and 0.1% inoculum levels, respectively. With total-body irradiation, all the animals surviving radiation toxicity developed tumors at the 10%-inoculum concentration. At the 1.0- and 0.1%-inoculum levels 5 of 16 and 2 of 19 animals, respectively, developed tumors. The daily radiation doses varied from 77 to 151 R/day. The largest local tumors occurred in mice pretreated with x radiation where the mean tumor sizes were not appreciably different from those of isologous controls. In animals pretreated with leurocristine, however, local tumor size was never more than 50–75% of control values. The results obtained with leurocristine on DBA/2 skin graft survival in CAF_1 mice also suggested that leurocristine may be effective as a suppressor of host immunity. (BBB)

8839 THE EFFECTS OF X RAYS ON THE MITOSIS OF PLANT CELLS. Shui Hao and Ching-chun Yang. Chih Wu Hsueh Pao, 11: 8-15(1963).

The seeds of *Helianthus annuus* and *Vicia faba* were irradiated with x rays at a dose rate of 71.4 R/min when the primary roots were just emerged from the seed coats. The irradiated and control seeds were germinated in wet sawdust. The root tips of *Helianthus annuus* were fixed in Nawashin's fixative solution at several times during a period of 3-4 days after irradiation. The materials were embedded in paraffin, cut in serial sections, and stained with hematoxylin. The resting and dividing cells in a definite region of the meristem were counted to determine the mitotic rate. In normal roots the mitotic indices were 15.78 ± 0.230%, while in the roots that received 50, 100, 300, 700, and 1,000 R x irradiation, the mitotic indexes were 13.83 ± 0.211, 13.04 ± 0.218, 13.10 ± 0.249, 12.1 ± 0.202, and 11.54 ± 0.192%, respectively. It was obvious that by this time the mitotic activity of irradiated roots was still slightly inhibited. The root tips of *Vicia faba* were fixed at several times during a period of 12-13 days after irradiation. In normal roots of *Vicia faba* the mitotic indexes were 10.76 ± 0.201% while in the roots that received 10, 50, 100, 300, and 700 R x irradiation, the mitotic indexes were 12.11 ± 0.180, 12.38 ± 0.186, 13.08 ± 0.203, 12.4 ± 0.232 and 5.84 ± 0.167%, respectively. The data of the phase ratios in normal and irradiated roots were analyzed. It was concluded that the mitotic activity of the roots of *Vicia faba* was stimulated by 10-300 x rays at a period of 12-13 days after irradiation. (Sci. Abstr. China, Biol. Sci., 2: No. 1, 1964).

8840 COMPARATIVE RADIOSENSITIVITY, WITH RESPECT TO γ RADIATION OF CERTAIN SPECIES OF SCORPION. Max Vachon, Pierre Niaussat, John H. Ebersole, and Claude Grenot (Naval Medical Research Inst., Bethesda, Md.). Compt. Rend., 259: 3389-91(Nov. 9, 1964). (In French)

Radioresistance to γ radiation varies considerably with the species of scorpion. The results, up to the present, suggest possible correlations between the radioresistance, the ecological characters of the biotype, and the toxicity of the venom. The scorpions of arid zones whose venom is very toxic are more resistant to γ radiation than species living in non-desert regions and whose venom is not very toxic. (tr-auth)

8841 REPRODUCTION OF IRRADIATED MONKEY KIDNEY CELLS: OBSERVATIONS ON FIXED STAINED CULTURES AND BY PHASE CONTRAST CINEMATOGRAPHY. P. Verani and D. Balducci (Istituto Superiore di Sanita, Rome). Experientia, 20: 680-2(Dec. 15, 1964).

Studies were made on the reproduction of irradiated monkey kidney cells, using both fixed stained preparations and phase contrast cinematography. In irradiated monkey kidney cells, it was observed that two or more days after irradiation some cells appeared with the nuclei dividing directly by amitosis. The relation between the number of cells that began mitosis and the number that had nuclei dividing by amitosis, established by observations on fixed stained cultures, was revised according to the value of the data provided by cinematography. The mechanism by which the nuclei divided by amitosis required, in some cases, more than twice the time necessary for a cell dividing by mitosis. Therefore the reported percentages can have only an indicative function, because they would be modified as a function of the time of evolution of each process. (P.C.H.)

8842 THE KINETICS OF GLUCOSE METABOLISM IN FASTED, IRRADIATED RATS STUDIED WITH A NEW TECHNIC OF CONTINUOUS INFUSION OF LABELED GLUCOSE. R. Masironi (Università, Rome). Farmaco (Pavia) Ed. Sci., 17: 3-10(Jan. 1962). (In Italian)

The rate of glucose metabolism in irradiated fasted rats was determined by means of the continuous infusion of ^{14}C-labeled glucose through indwelling cannulae inserted in the carotid artery and jugular vein. The animals were fasted 24 hr before being irradiated with 820 R from a ^{60}Co source. The unirradiated fasted controls showed a very low initial level of hepatic glycogen and plasma glucose which was followed by a marked increase of both, due to glyconeogenesis, after the third day of fasting. In contrast, the irradiated animals, after two days of fasting, showed a 3-fold increase of the hepatic glycogen (to 897.1 mg/100 g of liver) and of plasma glucose (to 125.5 mg/100 ml), but the specific activity of plasma glucose was decreased and the glycogenolysis was not affected. The changes of the muscle glycogen content were more or less the same as in liver, but were not as marked and consistent. An increase of hepatic glycogen was attributed to the stimulation of the glyconeogenesis induced by the irradiation and the increase of glucose to the utilization of the newly formed glycogen. (BBB)

8843 EFFECTS OF X-RAY IRRADIATION ON HEPATIC REGENERATION. Tiberiu Maros, Ludovic Seres-Sturm, and Carol Rettegi. Fiziol. Normala Patol. (Bucharest), 9: 19-24(1963). (In Rumanian)

Investigations were carried out in 180 white rats with regard to the effects of x irradiation on hepatic regeneration, after partial hepatectomy. A 300 R dose was centered upon the hepatic and cephalic regions. Increase in weight of the liver was slower than in non-irradiated control animals. X irradiation inhibited cellular division and produced alterations of the cell nuclei and steatosis of the hepatic parenchyma. The fact that these lesions were obvious only in animals having undergone liver resection points to the functional role of the liver in inducing a hepatic dystrophic process. It is assumed that x irradiation does not act only directly but also by means of the central nervous system. (auth)

8844 SPORES OF MICROORGANISMS. XV. THE ALTERATION OF HEAT SENSITIVITY AND ITS RELATION TO RADIATION RESISTANCE OF BACTERIAL SPORES. V. Vinter and B. Vechet (Inst. of Microbiology, Prague). Folia Microbiol. (Prague), 9: 238-48(July 1964).

A study was made of the heat resistance of spores of *Bacillus cereus* treated during the second sporulation phase by addition of cysteine or its analogue, thioproline, to the medium. Special attention was paid to the initial phase of heat inactivation, in which the effectiveness of a thermoprotection mechanism can be detected. Since previous results indicated that the mechanisms of heat and radiation protection in spores are largely independent of one another, the course of inactivation of x-irradiated spores was also studied. Addition of cysteine or thioproline (1 to 5 × 10^{-4}*M*) to the culture at the outset of the formation of prespores, i.e. before the commencement of dipicolinic acid (DPA) synthesis, led to the death of some of the cells and injured the thermoprotection mechanism of the surviving spores. In control spores with a high DPA content, inactivation by heating at 85°C was preceded by a lag phase, while in cysteine- and thioproline-treated spores this lag phase was completely absent and the death rate of most of the spores (D value = 17) was actually higher than the final death rate of the control spores (D value = 33). A small proportion of the spores in inhibited cultures (less than 10%) displayed almost the same heat resistance as untreated spores. The heat sensitivity of treated spores was greater than anticipated from their DPA content. The course of x-ray inactivation of the spores showed that cysteine and thioproline did not raise the sensitivity of the spores to radiation, but actually slightly raised their radiation resistance. The radioresistance of both types of spores was practically the same. All the curves show the usual multiple-hit type of inactivation. In the thioproline- and cysteine-treated spores radioresistance started to develop about 60 to 90 min before the appearance of mildly refractive prespores when formation of a cystine-rich protein structure begins. Radioresistance continues to develop and formation of the cystine-rich structure is completed in the later phase. It is concluded that if cysteine and thioproline are added at the outset of the second stage of sporulation, they can seriously injure the thermoprotective mechanism of the spores without inhibiting their radiation resistance. These results provide further support for the hypothesis that the mechanisms of these two types of spore resistance can be largely independent of one another. (BBB)

8845 PRESERVATION OF FRESH UNFROZEN FISHERY PRODUCTS BY LOW-LEVEL RADIATION. II. ORGANOLEPTIC STUDIES ON RADIATION-PASTEURIZED SOFT-SHELL CLAM MEATS. T. J. Connors and Maynard A. Steinberg (Bureau of Commercial Fisheries Technological Lab., Gloucester, Mass.). Food Technol., 18: 113-16(Aug. 1964).

The effect of different levels of radiation on the quality and shelf life of soft-shell clam meats was studied using two kinds of organoleptic determinations. To detect quality changes, clams were subjected to different levels of irradiation (250,000 to 550,000 Rad) and stored under different temperatures (33 and 42°F) and different gaseous atmospheres (air and vacuum). To determine acceptability, clams were irradiated and stored under the conditions which gave a product least different from the control. Doses of 350,000, 450,000, and 550,000 Rad extended the shelf life at 33°F from an average of five days to at least 30 days. At 42°F, the shelf life was extended from two or three days to 20 days, but the quality was lower than that of clams stored at 33°F for the same period. For air-packed clams, 450,000 Rad resulted in a product less different from fresh controls than did 250,000, 350,000, or 550,000 Rad. For vacuum-packed clams, 350,000-Rad irradiation resulted in a product less different from fresh controls than did 250,000-, 450,000-, or 550-000-Rad irradiation. After 20 days at 33°F, air-packed clams irradiated at 450,000 Rad and vacuum-packed clams irradiated at 350,000 Rads were as acceptable as freshly shucked unirradiated fried clams. After 30 days at 33°F the irradiated clams were still acceptable, but less so than freshly shucked unirradiated fried clams. After 20 days at 33°F, irradiated clam meats lost their firm appearance and became flaccid, presumably because of proteolysis. This gave the fried product a desirable tenderness not found in unirradiated clams. More fluid exuded from irradiated than control clams, and this was greater in clams dug in autumn than winter or spring. (BBB)

8846 PRESERVATION OF FRESH UNFROZEN FISHERY PRODUCTS BY LOW-LEVEL RADIATION. III. THE EFFECTS OF RADIATION PASTEURIZATION ON AMINO ACIDS AND VITAMINS IN CLAMS. R. O. Brooke, E. M. Ravesi, D. F. Gadbois, and M. A. Steinberg (Bureau of Commercial Fisheries Technological Lab., Gloucester, Mass.). Food Technol., 18: 116-20 (Aug. 1964).

As reported above, vacuum-packed clams (Mya arenaria) γ irradiated in cans at 350,000 Rad and air-packed clams irradiated in cans at 450,000 Rad are organoleptically acceptable after 30 days' storage at 33°F. The present study determined the effects of radiation at these levels and at a level of 4,500,000 Rad on the amino acids and B vitamins of clams, and compared changes with those that result from such practices in the commercial preservation of clam meats as storage at 33°F and heat-processing in cans. During 5-day storage at 33°F, clam meats showed a progressive decrease in free amino acid content, and steaming further reduced the amount of extractable amino acids. Heat-processing for 20 min at 240°F caused a smaller decrease in free amino acids than did steaming. Irradiation of air-packed clams at 4,500,000 Rad caused an increase of about 40% in the free amino acid content of raw clams. Irradiation of air-packed clams at 450,000 Rad, followed by storage for 30 days at 33°F, caused an increase of about 50% in the free amino acid content of raw clams. Irradiation of vacuum-packed clams at 350,000 Rad, followed by storage for 30 days at 33°F, caused an increase of about 70% in the free amino acid content of raw clams. Total amino acids or B vitamins of clam meats were not changed significantly by 5 days at 33°F, heat-processing, and storage at room temperature for 12 months, or irradiation of: (1) air-packed clams at 4,500,000 Rad; (2) air-packed clams at 450,000 Rad followed by 30 days at 33°F; or (3) vacuum-packed clams at 350,000 Rad followed by 30 days at 33°F. In general, the amino acids and B vitamins of clam meats were affected only slightly by radiation or radiation and storage, the changes being no more significant than those caused by refrigerated storage or heat-processing. (BBB)

8847 COMPLEMENTATION BETWEEN ad-5/7 ALLELES IN YEAST. W. P. Costello and E. A. Bevan (Oxford Univ.). Genetics, 50: 1219-30(Dec. 1964).

One hundred five yeast strains mutant at the ad-5/7 locus were isolated. Twenty-seven were induced by uv and 78 by ethyl methyl sulfonate. On the basis of their complementation reactions in diploids derived by crossing each of them with standard tester strains, and with one another; three types of mutant alleles are distinguished, termed ad-5, ad-7, and ad-5-7. The term ad-5/7 is used for unclassified mutant alleles. Induced ad-5/7 mutations include relatively fewer ad-5-7 strains than were isolated as spontaneous mutants by Roman and Dorfman. The complementation reactions of seven ad-5-7, 31 ad-5, and 59 ad-7 mutant strains were determined. None of the ad-5-7 strains shows complementation either among themselves or with any of the ad-5 or ad-7 strains; they are total non-complementers. All ad-5 strains behave as a single complementation subunit: they never complement each other, but all of them complement all ad-7 strains. Ad-7 strains fall into many complementation subunits. In its simplest representation, the complementation map is a circle with a short tail segment; it thus differs from all other maps previously described. The circle incorporates 22, and the tail segment 6 subunits of the map. The uv-induced mutants alone give a linear map, whereas the EMS mutants alone give a map similar to that obtained from the combined results. Fifteen ad-7 mutant strains gave anomalous results in complementation tests. These were mapped so as to portray the least number of anomalous results. Most of the anomalous results are negative, when according to their general map position they should be positive (they should complement certain strains); they may be due to faulty bonding of enzyme subunits rather than faulty functioning of the enzyme once bound. It is suggested that the three types of allele ad-5, ad-7, and ad-5-7 may be the result of mutations at three different genes constituting an operon, that ad-5/7 is not a single locus. The high number of mutant ad-5-7 mutant strains obtained could then be accounted for by mutation of an operator gene. The comparative complementation patterns of uv and EMS induced mutants suggest that particular regions as well as particular subunits of the complementation map are affected more by one mutagen than the other. (auth)

8848 STRUCTURAL AND PHENOTYPIC DEFINITION OF THE ROSY CISTRON IN DROSOPHILA MELANOGASTER. Abraham Schalet, R. Peter Kernaghan, and Arthur Chovnick (Univ. of Connecticut, Storrs). Genetics, 50: 1261-8(Dec. 1964).

Studies of 73 Drosophila mutants with genetic changes involving the rosy cistron, as judged by their eye color phenotype, and 24 non-rosy visible or lethal mutants selected within a small chromosome segment including the rosy cistron, permit the following generalizations. There is only one cistron concerned with xanthine dehydrogenase activity in this region. There is no allelic complementation in the rosy cistron. Mutations restricted to the rosy cistron are viable under routine conditions. Lethal effects found with certain rosy mutants involve lesions within adjacent genetic units which are functionally and spatially distinct from the rosy cistron. (auth)

8849 GENETIC LOADS IN IRRADIATED EXPERIMENTAL POPULATIONS OF DROSOPHILA PSEUDOOBSCURA. Eduardo Torroja (Rockefeller Inst., New York). Genetics, 50: 1289-98(Dec. 1964).

The genetic loads were studied by two methods in Drosophila. First, the egg-to-adult viability has been determined in the progenies of matings in which the parents were full sibs, half sibs, or not closely related genetically. Secondly, the viability of individuals made homozygous for certain chromosomes by means of a series of crosses was measured in relation to that of their heterozygous siblings. The experiments conducted utilizing both methods lead to concordant results. The recently irradiated populations carry very heavy genetic loads, consisting mainly of genetic variants which are deleterious in heterozygous, and doubtless also in homozygous condition. Some 28 to 37 generations after the irradiation is discontinued, the genetic loads are found very greatly reduced, in fact, reduced below the levels observed in natural populations. The genetic variants composing the genetic loads in natural populations are evidently not random samples of the variants arising by mutation under the influence of irradiation. (auth)

8850 LETHAL AND SEMILETHAL CHROMOSOMES IN IRRADIATED EXPERIMENTAL POPULATIONS IN DROSOPHILA PSEUDOOBSCURA. Abd El-Khalek M. Mourad (Rockefeller Inst., New York and Univ. of Alexandria, Egypt). Genetics, 50: 1279-87(Dec. 1964).

Experimental Drosophila populations, in which some of the chromosomes were exposed in one generation to 16,000R of x rays, were studied approximately two and a half years later (estimated to correspond to between 28 and 37 generations). Frequencies of the second and third chromosomes lethal, semilethal, and quasi-normal in double dose were determined. Lethals and semilethals were much less numerous than they were immediately after the irradiation, although more frequent than before the irradiation. Few of the quasi-normal chromosomes were subvital in double dose. It is concluded that the genetic variants found in natural and in experimental populations are, because of the action of natural selection, very biased samples of those arising by mutation. (auth)

8851 CROSSING OVER NEAR THE CENTROMERE OF CHROMOSOME 3 IN DROSOPHILA MELANOGASTER FEMALES. David T. Suzuki and Dilys M. Parry (Univ. of

British Columbia, Vancouver). Genetics, 50: 1427-32(Dec. 1964).

Crossing over was measured in the st-in-ri-p^p regions in chromosome 3 in two consecutive five-day broods. The centromere is presumed to lie between in and ri. The presence of a reversed acrocentric compound-X chromosome with no free Y chromosome results in a five to tenfold increase in the total crossover distance between st and p^p in both broods. Gamma rays (4000 rads) and actinomycin D (50 μg/ml) increase crossing over in the st-in and ri-p^p region shows a greater increase relative to the control. It is suggested that the qualitative similarity of effect of three such diverse conditions indicates that these agents are not directly influencing the process of crossing over. (auth)

8852 THE GENETIC BASIS OF NATURAL VARIATION. VI. SELECTION OF A CROSSVEINLESS STRAIN OF DROSOPHILA BY PHENOCOPYING AT HIGH TEMPERATURE. Roger D. Milkman (Syracuse Univ., N. Y.). Genetics, 51: 87-96(Jan. 1965).

Selection for crossvein defects in Drosophila via phenocopy sensitivity at 36.5°C is a useful method. Selection increases sensitivity to other temperatures as well. This sensitivity is specific, relating to crossveins, but not to survival. Attempts to use this method as a detector of genetic variability are described, using unirradiated and x irradiated inbred flies. At the very low doses of irradiation used, any genetic variability produced was insufficient to cause a response to selection. (auth)

8853 CORRELATION BETWEEN THE AMOUNT OF RADIATION RECEIVED AND THE ACUTE SYMPTOMS OF A-BOMB VICTIMS IN HIROSHIMA. Haruma Yoshinaga (Hiroshima Univ.), Naomi Shohno, and Kiyosi Sakuma. Hiroshima Igaku, 16: 837-49(Sept. 1963). (In Japanese)

Statistical investigations on the correlation between the amount of radiation received and the acute symptoms of A-bomb victims in Hiroshima were made on 2036 cases. The amount of radiation was estimated for both the instantaneous and residual radiation. The investigations were made on the following acute symptoms: depilation, fever, diarrhea, nausea, vomiting, and bleeding (ecchymosis and mucous bleeding). A high correlation was found between the amount of radiation and symptoms such as depilation and fever, while only a low correlation was found in the other symptoms. The estimations suggest that the RBE (relative biological effectiveness) of neutrons in the A-bomb is smaller than 5 and ranges from 1 to 2. (auth)

8854 STUDIES ON MUTATIONS INDUCED BY RADIATIONS AND CHEMICALS. I. THE EFFECT OF THE COMBINATION OF RADIATION AND CHEMICALS ON THE GROWTH AND MUTATION FREQUENCY OF RICE. Takane Matsuo and Yoshiro Onozawa (Tokyo Univ.). Ikushugaku Zasshi, 10: 223-7(1960). (In Japanese)

The biological effects of chemicals combined with x rays or neutrons on rice seeds were compared with the irradiation of seeds by x ray or thermal neutrons only and the treatment of seeds by $Ca(NO_3)_2$, Colchicine, Diepoxybutane, or β-propiolacetone only. $Ca(NO_3)_2$, which was used as the neutron capture, gave only a slight effect on growth and fertility of M_1-plants and decreased the frequency of chlorophyll mutation in M_2 generation when seeds were treated with it just before the irradiation by neutron. Post-treatment of seeds by Colchicine increased the fertility of M_1-plant compared with the single irradiation, but gave no effect on mutation frequency when combined with x rays, and decreased the frequency when combined with neutrons. Diepoxybutane and β-propiolacetone had high effect on germination and survival of M_1-plants in single application or combined with radiation. However, increased fertility and mutation frequency of treated materials was found when the chemicals were used as post-treatment substances of x rays, but no effect on mutation frequency was found when they were combined with neutrons. As a result, the mutagenic chemicals seem to have some chemical action on the process of recovering the breakage of chromosome caused by x rays. (P.C.H.)

8855 STUDIES ON MUTATIONS INDUCED BY RADIATIONS AND CHEMICALS. 2. COMPARISON OF FREQUENCY OF MUTATION INDUCED BY X-RAY, NEUTRON AND DIEPOXYBUTANE. Takane Matsuo and Yoshiro Onozawa (Tokyo Univ.). Ikushugaku Zasshi, 11: 295-9 (1961). (In Japanese)

A comparison investigation was made on the chlorophyll mutants and visible, viable mutants in M_2 generation and mutations in quantitative characters in M_3 induced by x rays, thermal neutrons, and diepoxybutane at the LD_{50} dose on dormant rice seeds. Frequency of chlorophyll mutation at the seed-bed period was highest in neutron treatment, followed by the x rayed plot, and lowest in the plot of diepoxybutane treatment. The visible and viable mutants at the heading time and maturity stage were also produced in maximum by neutrons, followed by x rays, and minimum by diepoxybutane, though there appeared to be some differences in spectrum. The proportion of the frequency of viable mutation to that of chlorophyll mutation was also changed by mutagens. Although neutrons gave the highest frequency of visible and viable mutations, they also produced the highest number of low fertile strains. The reverse was true in the case of diepoxybutane. The strains derived from M_1-plant, which segregated the chlorophyll mutants in M_2 seed-bed, produced more viable mutants at maturity stage as compared with strains from M_1 which did not segregate chlorophyll mutants in M_2 seed-bed. The genetic variances of the stem length and grain weight in M_3 generation were increased by treatment, but their mean values were almost the same as those of non-treated. It appeared that the variances increased both positively and negatively by treatments. The variances were also largest in neutron and smallest in diepoxybutane treatment. (P.C.H.)

8856 STUDIES ON MUTATION BREEDING IN BARLEY AND WHEAT PLANTS. I. ON THE γ-RAY-INDUCED SEEDLING MUTATIONS IN BARLEY. Masayuki Toda, Shohei Miki, and Takeshi Nakata. Ikushugaku Zasshi, 13: 224-8(1963). (In Japanese)

Observations were made on seedling mutations that appeared in gamma irradiated dormant seeds of a variety, Kōgen Mugi, of six-rowed barley. 21% (35 strains) of R_1^1- · $R_{1.3}^2$- and $R_{1.4}^2$-strains after doses of 30,000 R chlorophyll mutated strains were found, in a total of 164 mutated strains, indicating abnormal ratios of segregation. Such abnormalities may be caused by chromosomal changes, especially chromosomal deficiency. This fact is of great importance in relation to the method of finding mutated strains and that of treating mutated ones which indicate abnormal ratios of segregation. The kinds and frequencies of chlorophyll mutations varied with environmental conditions such as temperature and light resulting from differences in seeding seasons and fields. As to the induction of mutants, repeated irradiation for two successive generations was more efficient than for one generation only. The various categories of chlorophyll mutants were obtained in the same relative frequencies as observed by others. Seedling mutations that differed from chlorophyll mutations were also found. These seemed to be caused by chromosomal changes. (P.C.H.)

8857 THE EFFECT OF MICROWAVES ON THE BIOLOGIC RESPONSE TO IONIZING RADIATION. J. W. Howland and S. Michaelson (Univ. of Rochester, N. Y.). Ind. Med. Surg., 33: 500(July 1964).

Experiments indicated that continuous microwave exposures of dogs at levels of 20 mw/cm^2 produce no permanent measurable changes. At a physiologically tolerated level of 100 mw/cm^2 of pulsed microwave (2800 Mc/sec), animals are less sensitive to simultaneously administered lethal levels of ionizing radiation (250-kv x rays) than are controls receiving ionizing radiation alone. This simultaneous exposure to both radiations results in an early and more marked recovery of the granulocytes, indicating bone marrow stimulation. Dogs which have been acclimated to microwave exposure also show an increased resistance to whole-body, partial-body, and head-only exposures to ionizing radiation.

Certain hematologic changes may partially explain these observations. (BBB)

8858 EFFECT OF IRRADIATION IN TOMATO. N. S. Dhesi and K. S. Nandpuri (College of Agriculture, Ludhiana, India). Indian J. Genet. Plant Breeding, 24: 191-4(July 1964).

A description is given of some of the mutants arising after the γ irradiation of air-dried seeds of the Sioux variety of tomato. Three dose levels were used: 20,000, 30,000, and 40,000 R. Earliness was affected with seeds treated with 20,000 R, this dose delaying fruit ripening. However, some plants from the treated material were found in X_2 generation which were much earlier than the untreated plants. The number of branches were greater in treated than in the untreated material. Among the treated material, a 20,000 R dose gave fewer branches than the other two doses. The largest number of branches was obtained with the highest dose, 40,000 R. The germination percentage of the treated seeds was less in all cases as compared with the untreated seeds. Germination of seeds decreased with increasing doses of γ rays; the highest dose of 40,000 R gave the lowest percentage germination (41.0). Some plants having different growth and fruit characters than the parent variety were observed. In terms of number of fruits, the overall differences among the treated and untreated material were not significant. However, some plants were observed bearing a larger number of fruits. One such plant gave 86 fruits as compared with the mean fruit number of 40 in untreated plants. One plant was found, among the plants raised from the seeds treated with 30,000 R, having a very thick stem (20-mm dia). This plant was erect in habit. Some changes were also noted in plant height and fruit shape. In the 40,000 R treatment, a plant 125 cm long was found. It behaved like a vine, and did not stand up. It yielded fewer fruits, which were long in shape and small in size. One plant was found having compact fruits, from the plants grown from 40,000 R treated seed. The length of the fruit stock in this plant was greatly reduced and fruit appeared to be attached to the main stem only. (BBB)

8859 THE EFFECT OF RADIATION ON THE NERVOUS SYSTEM — AN ELECTROENCEPHALOGRAPHIC STUDY. E. Klimková-Deutschová and B. Roth. Intern. Arch. Gewerbepathol. Gewerbehyg., 20: 1-10(Mar. 19, 1963).

EEG findings in 46 persons, the majority of whom were exposed to centimeter and meter waves in their work were studied; one person was exposed to x rays. The subjective complaints were mainly of a neurotic character combined with tiredness. The objective finding was vegetative disregulation in most cases. Comparison of the clinical symptoms with the EEG results showed a predominance of inhibitory processes. The predominance of sleep rhythms in the EEG led to the conclusion of mesodiencephalic damage. The EEG method is of value in evaluating subjective radiation injury and for prognostic and occupational health purposes. (Occupational Safety Health Abstr., 2: No. 1, 1964)

8860 THE EFFECTS OF PRESOWING AND IRRADIATION OF SEEDS WITH γ-IRRADIATION FROM ^{60}Co AND WITH NEUTRONS ON THE TECHNOLOGICAL CHARACTERISTICS OF RAW COTTON AND THE AMOUNT OF FIBER PRODUCED. R. E. Eyubov. Izv. Akad. Nauk Azerb. SSR, Ser. Biol. i Med. Nauk, No. 2, 67-71(1962). (In Russian)

Exposure of cotton seeds to γ radiation or neutrons stimulated the growth and development of plants grown from the irradiated seeds, increased the yield of raw cotton, and resulted in improved fiber characteristics. Doses of γ radiation of 1000 to 50,000 R were used. Results showed that doses of 1000 to 10,000 R stimulated growth and development and resulted in improved yield of raw cotton, and doses of 10,000 to 20,000 R resulted in the best improvement in fiber characteristics. Neutron irradiation of seeds at 10^8 neutrons/cm^2 stimulated plant growth and development and improved fiber characteristics. Fiber quality was improved in some cases by treatment of the irradiated seeds with a 0.005% solution of petroleum growth-stimulating substances. (C.H.)

8861 EQUIVALENCE OF X-IRRADIATION IN VIVO OR IN VITRO ON MOUSE OOCYTE SURVIVAL. Laurel E. Glass and Thomas R. McClure (Univ. of California, San Francisco). J. Cellular Comp. Physiol., 64: 347-53(Dec. 1964).

Ovum transplantation techniques were used to compare the effects of x-irradiation on mouse eggs in vivo or in vitro. Ovulation was induced in recipient Cal A and in donor C3H female mice. After irradiation (0, 100, 200, or 250 R), six donor eggs were transferred to the right ovarian bursa of each of 256 non-irradiated, mated recipients. Two groups of donor females received whole-body x irradiation shortly after ovulation. Eggs from one group were transferred immediately after irradiation to recipient (in vivo-direct transfer). Eggs from the second group were placed in a polyethylene capillary tube for about one hour before transfer to recipients (in vivo-tube transfer). Two other groups of eggs were removed from non-irradiated donors, x irradiated in a polyethylene capillary tube, and then transferred to recipient females (in vitro-vaseline seal; "in vitro-pressure seal"). Recipients were sacrificed after the seventeenth day of gestation. Donor and native fetuses, living and dead, were counted as were resorption sites. As x irradiation dose to donor eggs increased, the number of living donor fetuses decreased. There was no significant difference between irradiation or transfer methods. It was concluded that in vivo x irradiation is not more deleterious to mouse oocytes than is in vitro x irradiation. As the number of living donor fetuses decreased with increasing irradiation doses, the number of living native fetuses in the same uterine horn increased. These data support the hypothesis of competition between native and donor eggs for uterine implantation sites. However, there was no change in the number of resorption sites in the right uterine horn and the total number of implantation sites declined. There was, therefore, increased pre-implantation death of donor oocytes with increasing doses of x irradiation. There were no consistent correlations between right and left uterine horns, either in numbers of total living fetuses, living native fetuses, or total implantation sites. (P.C.H.)

8862 MUTAGENESIS AND CHROMOSOME STRUCTURE. Frederick J. de Serres (Oak Ridge National Lab., Tenn.). J. Cellular Comp. Physiol., 64: Suppl. 1, No. 2, 33-42(Oct. 1964).

The spectra of forward-mutations occurring spontaneously (SP) or induced by x rays (X), nitrous acid (NA), or 2-aminopurine (AP) at the ad-3A and ad-3B loci of Neurospora crassa were compared by means of tests for allelic complementation and leakiness. Such tests showed a marked correlation between the percentages of leaky mutants and mutagenic origin. High percentages were found among the NA and AP samples and low percentages among the X and SP samples. The same trend was found with regard to allelic complementation among the ad-3B mutants. A set of testers derived from a 17-complon map of the ad-3B cistron also showed that complementing NA and AP mutants have predominantly nonpolarized complementation patterns with an average complon coverage of 4.7, whereas complementing X and SP mutants have predominantly polarized patterns with an average complon coverage of 13.6. The data provide striking evidence for mutagen specificity in Neurospora and suggest, furthermore, that there is a correlation between the type of genetic alteration and the type of complementation pattern. (auth)

8863 HOMEOSTASIS OF ANTIBODY FORMATION IN THE ADULT RAT. Donald A. Rowley and Frank W. Fitch (Univ. of Chicago). J. Exptl. Med., 120: 987-1005 (Dec. 1, 1964).

Passive immunization of rats with homologous anti-sheep erythrocyte serum markedly inhibited the primary antibody response to various doses of sheep erythrocytes. The markedly suppressive effect of specific antibody on the primary antibody response contrasted sharply with the absence of this effect on the secondary response. Antigen-antibody complexes formed *in vitro* elicited no measurable primary antibody response but did elicit a high secondary response. Exposure of normal spleen cells to the antibody *in vivo* or *in vitro* suppressed their response to the antigen in 600 R x-irradiated recipients. In contrast, cells from previously immunized animals transferred to x-irradiated animals produced antibody in the presence of passively given antibody. Thus, potential antibody-forming cells from normal animals were unresponsive to the antigen in the presence of specific antibody, while antibody-forming cells from previously immunized animals responded to the antigen in the presence of antibody. Presumably, antibody actively produced in small quantities by a few antibody-forming cells might inhibit antibody formation by potential antibody-forming cells. Confirmation of this was obtained by showing that some animals initially injected with small doses of antigen failed to produce measurable antibody to subsequent injections of larger doses of the antigen. Low doses of antigen capable of inducing unresponsiveness produced no measurable circulating antibody, but these doses did produce increased numbers of plaque-forming (antibody-releasing) cells in spleens of rats. Thus, the formation of specific antibody may provide a homeostatic or feed-back mechanism which controls or limits production of specific antibody to the portion of the antibody-forming system previously stimulated by the antigen. This mechanism may account in part for immunological unresponsiveness. (BBB)

8864 A SUMMARY STUDY OF DIRECT AND INDIRECT RADIATION DAMAGE UPON THE DEVELOPING EAR IN *AMBLYSTOMA*. Jean Piatt (Univ. of Pennsylvania, Philadelphia). J. Exptl. Zool., 156: 331-43(Aug. 1964).

Observations are reported concerning the development of nonirradiated ears orthotopically transplanted to x-irradiated hosts in the salamander, Amblystoma. An attempt was made to integrate these data with information previously published on the relative effects of direct and indirect radiation damage upon the developing ear. *A. punctatum* embryos were x irradiated with 200 R at stage 26, and 18 hr later two series of operations were performed. In series EX the right otic vesicle of a normal embryo was transplanted in place of the right vesicle of an irradiated embryo. In series XE the right otic vesicle of an irradiated embryo was transplanted in place of the right vesicle of a normal embryo. Left and right ears of animals were studied 5 to 30 days following transplantation. Of the irradiated animals of series EX few survived beyond the 30th day, and their overall development lagged behind that of the nonirradiated animals of series XE. The development of the left host ears in series XE is, as expected, normal and their differentiation and size at the five observational periods studied serve as the standard to compare the experimentally altered ears. The differentiation of the nonirradiated grafts in irradiated hosts is normal at all of the five stages of development studied. At the terminal stages of 20 and 30 days, differentiation of the grafts compares very favorably with the normal left ears of series XE. The size of the grafts, beginning with the 10th or 15th day, does not keep pace with the normal ears but they are always much larger than their irradiated left mates and larger than the irradiated grafts, except at the terminal stage of 30 days at which time the latter have surpassed them in size. Differentiation of the irradiated grafts in nonirradiated hosts is never entirely normal but is superior to that of the irradiated left host ears of series EX. Their size is always less than their normal left mates. In both differentiation and size the irradiated left host ears of series EX are inferior to all others. Irradiated ears in an irradiated environment develop more poorly than in a normal environment but an irradiated environment does not adversely affect the differentiation of nonirradiated ears. The smaller size of the nonirradiated grafts at 30 days is not an effect of the irradiated environment as such but the result of inability of the irradiated hosts to eat and grow. It is concluded that indirect radiation effects manifest themselves chiefly upon irradiated tissue, their effect upon nonirradiated tissue being insignificant or nil. (BBB)

8865 SPERMATOGENESIS OF THE SILKWORM AND ITS BEARING ON RADIATION INDUCED STERILITY. PART I. Toshihiko Sado. J. Fac. Agr. Kyushu Univ., 12: 359-85(Aug. 30, 1963).

A brief review is included on spermatogenesis in the silkworm, radiation effects on spermatogenesis, and radiation effects on silkworm germ cells. Studies were made on the relation between spermatogenesis of the silkworm and radioinduced sterility. It was concluded that irradiation of larvae in the early fifth instar causes firstly, a reduction in number of spermatozoa produced and secondly, the formation of non-functional sperm, resulting in the functional oligospermy of the treated insects. (P.C.H.)

8866 CHROMOSOME STUDIES ON *TRILLIUM KAMTSCHATICUM* PALL. AND ITS ALLIES. XXV. THE EFFECTS OF SOME CHEMICALS ON THE FREQUENCY OF X-RAY-INDUCED CHROMOSOME ABERRATIONS. Hajime Matsuura, Shigeyuki Tanifuji, and Masaki Iwabuchi (Hokkaido Univ., Sapporo). J. Fac. Sci. Hokkaido Univ., Ser. V, 8: 57-74(Dec. 1962).

Earlier studies on rejoining mechanism of the broken chromosome ends induced by x irradiation indicate that rejoining is prevented by the postirradiative treatments with protein synthesis inhibitors, thus indicating that protein synthesis is necessary for the occurrence of rejoining. Studies of the distribution of breaks over chromosome arms have often indicated that heterochromatic regions are more breakable than euchromatic parts. However, in Trillium chromosomes, it has been demonstrated that heterochromatic regions are unbreakable to x-ray irradiation when charged with nucleic acids. The present experiments were undertaken to decide whether the frequency of x-ray-induced aberrations and their distribution in heterochromatic and euchromatic regions are modified or not by the administration of some chemicals, i.e., chloramphenicol (a protein synthesis inhibitor), mitomycin C (an inhibitor of nucleic acid synthesis), and acriflavine (an inhibitor of respiration in bacteria). Their modifying effects on the frequency of x-ray-induced chromosome aberrations were investigated with the ovular tissue cells of *T. kamtschaticum*. Cytologic observations were carried out on the metaphase and ana- or telophase cells elapsed 42 hr after irradiation (60 R given 6 hr after chemical treatment). The results from metaphase cells showed an increase of two-hit aberration yield by the chloramphenicol and mitomycin treatments. As to the distribution of simple chromatid or isochromatid breaks, the relative frequency of the breaks in heterochromatic regions was increased by the mitomycin treatments. From the data on anaphase and telophase cells, it is concluded that mitomycin, acriflavine, and chloramphenicol treatments tend to inhibit the occurrence of sister reunion. It was presumed that sister reunion takes place a little more frequently in akinetic fragments than in kinetic ones. These data may be explained by the effect of the chemicals in inhibiting rapid rejoining of these metabolic inhibitors and further by the prolongation of both periods, open and joinable. It is apparent from the results of the treatment with chloramphenicol that protein synthesis is necessary for rejoining to occur. (BBB)

8867 CHROMOSOME STUDIES ON *TRILLIUM KAMTSCHATICUM* PALL. AND ITS ALLIES. XXVI. THE EFFECTS OF MITOMYCIN C ON THE FREQUENCY OF X-RAY-INDUCED CHROMOSOME ABERRATIONS. H. Matsuura, S. Tanifuji, Takashi Saho, and Masaki Iwabuchi (Hokkaido Univ., Sapporo). J. Fac. Sci., Hokkaido Univ., Ser. V, 8: 75-85(Dec. 1962).

Earlier it was shown that protein synthesis is necessary for the rejoining of broken ends as concluded from experiments employing mainly chloramphenicol, but it did not appear that DNA and RNA synthesis were involved in rejoining from the fact that chloramphenicol did not inhibit the incorporation of ^{32}P into the DNA of germinated Vicia seeds. However, in the present authors' previous experiments it was found that mitomycin C, which is known to inhibit specifically the synthesis of DNA in bacteria, inhibits the sister reunion at x-ray-induced broken ends and markedly increases relative frequency of heterochromatic breaks as compared with euchromatic ones. These combined experiments with mitomycin C and x rays (60 R doses) were carried out with the ovular tissue cells of *T. kamtschaticum*. It was shown that mitomycin C is effective in increasing the final yield of chromosome aberrations detectable at metaphase 48 hr after irradiation. The increase of two-hit aberrations was marked especially in the heterochromatin regions. These results are explained by assuming that the rapid rejoining of induced broken ends is inhibited and the rejoinable period after the recovery of rejoinability is considerably prolonged by the mitomycin treatment, and that these alterations are more effective in or near heterochromatic regions. Since mitomycin C is known to inhibit specifically the DNA synthesis in bacteria, its modifications effect on chromosome rejoining strongly suggests the involvement of DNA synthesis in this process. The fact that in the control samples the interchanges were more frequent in H segments suggests that biochemical process involved in synthesizing nucleic acids, which may promote the rejoining of breaks, proceeds more slowly in heterochromatin than in euchromatin. It is probable, therefore, that the DNA synthesis for rejoining is prevented by mitomycin more severely in heterochromatin. Moreover, the rejoining of broken ends in heterochromatin may be more inhibited by mitomycin and both the open period, during which the broken ends stay open, and the following joinable period may be prolonged more markedly in heterochromatin. (BBB)

8868 CHROMOSOME STUDIES ON *TRILLIUM KAMTSCHATICUM* PALL. AND ITS ALLIES. XXVIII. MODIFYING EFFECTS OF CHLORAMPHENICOL ON X-RAY-INDUCED CHROMOSOME ABERRATIONS. Hajime Matsuura and Shigeyuki Tanifuji (Hokkaido Univ., Sapporo). J. Fac. Sci., Hokkaido Univ., Ser. V, 8: 157-72(Dec. 1962).

The modifying effect of an inhibitor of protein synthesis, chloramphenicol, on the frequency of x-ray-induced chromosome aberrations was investigated with the pollen mother cells of *T. kamtschaticum*. The two-hit aberration yield increases to a certain degree by the combined chemical-radiation treatment. The alteration of the types and frequencies of the aberrations by the combined treatment was explained on the basis of the inhibition effect of chloramphenicol on the rejoining of broken ends, that is, the prolongation of their open-periods and following joinable periods. From comparison of the frequencies and types of rejoined breaks and of simple isochromatid breaks in each set of the treatments, it is concluded that some of isochromatid breaks after irradiation convert, when combined with chloramphenicol treatments, to the chromatid breaks which will result in chromatid-chromatid or chromatid-chromosome exchangers. Another experiment utilizing acriflavine indicated that its effect on the x-ray modification is not marked, when used at a concentration of 2×10^{-4}*M*. (BBB)

8869 CHROMOSOME STUDIES ON *TRILLIUM KAMTSCHATICUM* PALL. AND ITS ALLIES. XXIX. EFFECTS OF ATP AND DNA ON THE REJOINING OF CHROMOSOME BREAKS INDUCED BY X-RAYING. Hajime Matsuura, Takashi Saho, Shigeyuki Tanifuni, and Masaki Iwabuchi (Hokkaido Univ., Sapporo). J. Fac. Sci., Hokkaido Univ., Ser. V, 8: 173-200(Dec. 1962).

The effect of extraneously supplied ATP and DNA on the x-ray-induced chromosomal aberrations was studied in the ovular tissue cells of *T. kamtschaticum*. ATP conspicuously decreased the aberration yield, indicating that the rejoining of breaks involves metabolic processes requiring energy supply. DNA also considerably decreased the frequency of aberrations. It is suggested that DNA is degraded at least to the level of nucleotides and then incorporated for the reconstruction of chromosome continuity. Simultaneous application of DNA and ATP seems to bring about a cumulative effect in reducing the frequency of simple breaks. It was further noted that in the experimental groups which contain DNA singly or in combination with ATP the interchange frequency remains at or even increases more than the level of the control. When the two-hit aberrations observed were analyzed in regard to the loci of two breaks involved in an interchange, they could be grouped into three categories: the interchange between breaks both in heterochromatic regions (H–H), those between breaks both in euchromatic regions (E–E), and those between breaks in heterochromatic and euchromatic regions (H–E). Clearly the occurrence of interchanges is not random between breaks in heterochromatic and euchromatic regions. The majority of interchanges represents interheterochromatic or intereuchromatic ones. It is concluded that the heterochromatic regions in the resting nucleus are held together in close proximity and hence more interchanges are produced among them. (BBB)

8870 CHROMOSOME STUDIES ON *TRILLIUM KAMTSCHATICUM* PALL. AND ITS ALLIES. XXX. EFFECT OF POST-TEMPERATURE-TREATMENT ON X-RAY-INDUCED CHROMOSOME ABERRATIONS. Hajime Matsuura, Shigeyuki Tanifuji, Takashi Saho, Masaki Iwabuchi, and Senzi Takizawa (Hokkaido Univ., Sapporo). J. Fac. Sci., Hokkaido Univ., Ser. V, 8: 201-8(Dec. 1962).

The effects of post-treatments with high (27°C) and low (0 to 2°C) temperatures on the x-ray-induced chromosome aberrations were investigated mainly at the first metaphase in the pollen mother cells of *T. kamtschaticum*. All the post-treatments at 27°C for one, six, 18, and 48 hr were found to be very effective in decreasing the exchange yield, mainly chromatid translocations. It was shown that the maximum efficacy of this decreasing effect at 27°C is attained within one hr. In the case of six-hr treatment at 0 to 2°C, the frequency of exchanges and isochromatid breaks increased considerably. Low temperature treatment of longer duration (18 hr), however, brought about a conspicuous drop in the frequency of exchanges. Considering the anaphase and telophase aberration frequencies in these two low temperature treatments, it was assumed that the frequency of simple breaks, both chromatid and isochromatid types, are not different between these two groups. It is suggested that low temperature prevents the breaks from restitution, favoring the production of interchanges, while low-temperature treatment of longer duration leads the broken ends to lose their ability for rejoining, thus resulting in the decrease of exchanges. Since it has been shown that a supply of energy is necessary for the process of rejoining of broken chromosome ends, and also that protein and nucleic acid (especially DNA) syntheses involve in the rejoining process. Since these processes of energy supply and protein or nucleic acid synthesis are enzymatic, they are dependent on temperature. The present data strongly support this view of the rejoining mechanism. (BBB)

8871 IRRADIATION-INDUCED TEXTURAL CHANGE IN FRUITS AND ITS RELATION TO PECTIN METABOLISM. Laszle P. Somogyi and Roger J. Romani (Univ. of California, Davis). J. Food Sci., 29: 366-71(May-June 1964).

Textural changes of ^{60}Co-irradiated fruits and their relation to changes in pectin substances and pectin enzymes were studied in various fruit species and model systems, which were maintained under controlled conditions during and after irradiation. Irradiation was performed in a Mark II-type, 32,000–C ^{60}Co food irradiator that provided a γ-ray exposure of 300 krad/hr. Temperature was maintained at 65°F during irradiation in a closed container in which air or nitrogen was circulated prior to and during irradiation. Textural changes of pears and peaches exposed to 300, 600, and 900 krad were found to correspond to a decrease in protopectin content and an increase in pectin and pectate fractions of the fruits. Characterizations of the 70% alcohol-insoluble solids prepared from these fruits revealed only minor differences in respect to their anhydrouronide and acetyl content and degree of esterification. To account for the marked effects of radiation, activities of pectin enzymes extracted from irradiated fruits were investigated. Pectin methylesterase showed an increased activity immediately after doses of 300 and 600 krad, and enzymes extracted from fruit four days after irradiation had a reduced activity. Pears, peaches, and nectarines irradiated under nitrogen atmosphere softened much less than fruits irradiated under air. While this may be attributed to the reduced formation of free radicals under anoxic conditions, a further experiment with pectin solutions exposed to γ radiation under similar atmospheric conditions did not support this suggestion. The changes in 1% pectin solutions were related to radiation dose, but were remarkably similar regardless of the presence or absence of oxygen during exposure. It is suggested that radiochemical changes in the pectin, as indicated by reducing power or viscosity, are direct radiation effects rather than mediated by oxidizing radicals. (BBB)

8872 IMMUNOLOGIC STATUS OF THYMECTOMIZED ADULT RATS. Alan C. Aisenberg and Barbara Wilkes (Massachusetts General Hospital, Boston). J. Immunol., 93: 74-80(July 1964).

Immunologic function of thymectomized adult rats was assessed by determining the antibody response to bovine serum albumin and sheep cells, the delayed skin reaction to bovine serum albumin and tubercle bacilli, and the peripheral lymphocyte count. Only minimal immunologic impairment was observed in rats thymectomized as adults as long as a year after operation, and similar minimal impairment was observed after sublethal (430-R) irradiation of these animals. Lethal irradiation and bone marrow restoration of the unoperated adult resulted in a moderate depression of antibody formation, delayed hypersensitivity, and peripheral lymphocyte count. However, depression of these parameters was much more marked in the thymectomized adult rat after lethal irradiation, indicating that immunologic function of the thymus persists into maturity. In addition to the depression of immunologic function which can be demonstrated after lethal irradiation, the higher mortality of thymectomized rats following lethal and sublethal irradiation suggests that the adult rat thymus is not vestigial. The most ready explanation of this higher mortality is that the immunologic impairment of thymectomy places these animals at a disadvantage in combatting the infectious complications of the postirradiation state. (BBB)

8873 PHOSPHORUS-32 DISTRIBUTION AND P FRACTIONS IN THE ORGANS OF THE ALBINO RAT WHOLE-BODY IRRADIATED WITH ^{60}Co. EXPERIMENTAL STUDIES OF THE RISE AND FALL OF ^{32}P. Shigekazu Maeda, Yoshihiro Ikejiri, Toshiyuki Jikuhara, Yasushi Kasahara, and Seiji Takeuchi (Osaka Municipal Univ. School of Medicine). J. Japan Obstet. Gynecol. Soc., 10: 125(Apr. 1963).

Studies were performed on rats to detect the alterations in P distribution in body, the daily variation of P fractions, and the change in the exchange of maternal ^{32}P to the fetus, due to ^{60}Co irradiation. The ^{32}P uptake in the blood, liver, kidney, and testis was higher after irradiation than in the control group. There was no noticeable effect of irradiation in the ovary or adrenal gland ^{32}P uptake. The distribution of ^{32}P in the testis of the irradiated group did not show any change. The ^{32}P distribution was very high in bone, spleen, adrenal gland, and brain of fetuses born of mothers who were given ^{32}P before or during pregnancy, whereas when male rats were given ^{32}P before mating ^{32}P shift into the fetal brain was not noted. As to the P fractions, acid-soluble ^{32}P distribution in the testis and liver became elevated, and daily increases of ^{32}P distribution were noted in the testis. In regard to the nucleic acid P fraction, ^{32}P uptake in liver or testis increased after irradiation. The ^{32}P in the protein P fraction increased in the liver but was not altered in the testis after irradiation. (BBB)

8874 X-IRRADIATION INDUCED ACUTE BRAIN DAMAGE AS A FUNCTION OF AGE. Duane A. Diller, Robert H. Brownson, and Daniel B. Suter (Medical Coll. of Virginia, Richmond). J. Neuropathol. Exptl. Neurol., 23: 446-56(July 1964).

Previous studies of neuroglial radiosensitivity demonstrated necrosis of oligodendroglial cells in young adult rat brains six to 24 hr following exposure to x rays in doses of 1200 R. Since the previous work demonstrating altered oligodendrocytes employed only adult rats of one month of age, a study was undertaken to determine the effects on the neuroglial response to x irradiation in rats of various ages. Holtzman female albino rats aged one week to one yr received a single dose of 5000 R delivered at 930 R/min by a 1000 kvp x ray unit, collimated to a circle 16 mm in diameter on the dorsum of the head. The one-week-old irradiated animals were not as active as their control litter mates and appeared retarded in growth. A weight loss among the older animals one week after irradiation ranged between 30 and 40% of their preirradiation weight. Only mild behavioral changes were noted and these only in the one-week-old animals, which displayed a tendency to wander from the nest, whereas the control litter mates remained in a cluster. Gross examination of the one-week-old irradiated brains revealed enlarged ventricles, especially at one week postirradiation, and these brains were softer than the control brains of the same age group. No gross differences were apparent in the other age groups. Histologic examination revealed major differences in response to radiation. In the one-week-old group there was abundant damage including neuroglial cell degeneration. In contrast, changes in the one-year-old group were virtually absent. The areas of necrosis where the altered cells were numerous included the hippocampus, corpus callosum, and subependymal layer of the lateral ventricle. As shown previously, peak incidence of altered cells occurred at six hr postirradiation, followed by a return to control values by 48 hr. In the one-year-old group the counts were not significantly different from control values. In the six-month-old group there was a slight but significant increase over control values but only at six hr postirradiation. In the one-month-old group the incidence of altered cells at six hr postirradiation was ~20 times that of the nonirradiated controls. In the one-week-old group at six hr postirradiation the number of altered cells was over 200 times the control numbers in that group and 24 hours after irradiation there still remained 15 times more altered cells than in the controls. Hence, from one week to one month of age, there appeared an ~10-fold decrease in radiosensitivity as measured by this parameter. (BBB)

8875 EFFECTS OF NEONATAL GAMMA IRRADIATION ON HORMONE PRODUCTION AND SPERMATOGENESIS IN THE TESTIS OF THE ADULT PIG. B. H. Erickson (Univ. of Tennessee, Oak Ridge). J. Reprod. Fertility, 8: 91-100(Aug. 1964).

The response of the neonatal pig testis to a single total-body exposure of ^{60}Co irradiation was determined, and changes in the nonirradiated germ cells and Leydig cells are described. Male pigs of mixed breeding received a 200 R whole-body dose at 1, 4, 6, 12, 18, 20, 22, 25, or 30 days of age. To determine the more immediate effects of irradiation on the germ cells, boars from each age group were orchidectomized 10, 20, 30, 40, or 60 days after irradiation. The remaining irradiated boars were kept for semen and urinary steroid analyses when 14 months old. Histologic study was directed toward the morphogenesis of the Leydig cells and germ cells during the first 130 days after birth in relation to estimates of cellular radiosensitivity. The number of gonocytes (primitive germ cells) declined to 10% of the control values by day 30 after irradiation, but at day 60 some recovery was evident. Postpubertally, an average of 23% of the seminiferous tubules seen in transverse section in the irradiated testes exhibited radiation damage which was presumably permanent. Average sperm production was 57% of the control value. Increased numbers of crenated nuclei and a delay in morphogenesis were noted among the Leydig cells before puberty. Urinary steroid output of the irradiated boars equalled or exceeded that of the nonirradiated boars, indicating that 200 R of γ rays effected no permanent damage among the Leydig cells. It is concluded that within the testes, germ-cell radiosusceptibility appears to be the factor which limits the fertility of the neonatally irradiated boar. These results are discussed and correlated with previous findings on germ-cell sensitivity in the pig and other mammals. (BBB)

8876 A CHROMOSOME STUDY OF NONTREATED AND AN IRRADIATED HUMAN *IN VITRO* CELL LINE. Michihiro C. Yoshida and Sajiro Makino (Hokkaido Univ., Sapporo). Jinrui Idengaku Zasshi, 8: 39-45(1963).

Attempts were made to establish human diploid strains of fetal tissue origin. Chromosomal conditions are reported as observed in a diploid nontreated cell line maintained for as long as 47 subculture passages for 340 days, together with data on an irradiated line maintained for 12 transfer passages. The primary culture was made from lung cells (fibroblasts) derived from a four-month female fetus. The culture was separated into two groups at the third passage, at which time irradiation experiments were undertaken. The culture was exposed to x rays on the second day of cultivation, with a 180 kv x-ray machine at a dose rate of 42.7 R/min at room temperature. The effective dose on the cells appeared to be ~200 R. Normal diploidy and normal karyotype were retained in cells from the untreated line until the 47th passage for 340 days. The frequency of tetraploid and other aberrant cells suddenly increased just prior to the beginning of cell degeneration during the 45 to 47 passages. In the irradiated cell line, normal diploidy was retained for as long as 12 passages over 100 days. Polyploidy and variations of the chromosome number were common in cells of earlier passage, but in last half subcultures diploid cells were predominant in cell populations. The frequency of affected cells showing chromosome aberrations was 12.0%. The aberrations involved structural changes of chromosomes as represented by breaks and minute fragments. In the irradiated cell populations of the first and second subculture, the incidence of normal cells was slightly reduced as a result of radiation effects with the appearance of several polyploid or aberrant cells, but a normal diploid number, 46, had been retained as a modal number. In the 3rd to 6th passages, cell populations showed no polyploid cells. Through these passages the modal chromosome number was 46. In the cell population of the 7th subculture, polyploid cells were 2.6% in frequency. Polyploidy and other variations of chromosome number were observed in cell populations of later subcultures. Generally, however, through serial subcultivations in the irradiated series, cells showing chromosome abnormalities were extremely low in occurrence, and the vast majority of cells had a normal chromosome complement, 46 in number. (BBB)

8877 EXPERIMENTAL STUDIES OF THE ROLE OF FREE RADICALS IN RADIATION-INDUCED CHROMOSOMAL DAMAGE. Shui Hao, Ching-chun Yang, Yu-hsin Wang, Su-chin Feng, and Fu-yung Chang. K'o Hsueh T'ung Pao, No. 3, 52-4(1963).

Seeds of *Vicia faba* were soaked in water at room temperature, and the primary roots of seeds were treated with $10^{-4}\underline{M}$ and $10^{-5}\underline{M}$ solutions of $FeSo_4$ for 1.5 hours. Then the seeds were exposed to 500 R of x rays at a dose rate of 51 R/min. The root tips were fixed in Carnoy's fixative (3:1) and stained with acetocarmine or hematoxylin, squashed and examined microscopically for chromosome damage (bridges and fragments) at late anaphase and early telophase of the first cycle of mitosis. In the irradiated roots 24.82 ± 0.95% cells with chromosome damage were observed, where-as in the roots that were treated with $FeSo_4$ before irradiation 44.30 ± 1.06 ($10^{-4}\underline{M}$ $FeSo_4$) and 37.95 ± 1.03 ($10^{-5}\underline{M}$ $FeSo_4$) cells with Chromosome damage were observed. In the roots that were treated only with $FeSo_4$, the frequency of cells with chromosomal damage was less than 1%. The numbers of cells with abnormal chromosome were not only not increased, but slightly decreased, if the seeds were treated with $0.06\underline{M}$ solution of KI and then with $10^{-4}\underline{M}$ solution of $FeSo_4$ before the irradiation. Therefore it was concluded that the action of free radicals caused the chromosome aberrations to increase, in the case of roots treated with $FeSo_4$ solution before irradiation. If the roots were treated with KI only before x irradiation, there was a small decrease in number of cells with chromosomal damage. It is suggested that the OH free radicals play a minor role in chromosome damage by x irradiation. (TCO)

8878 THE INFLUENCE OF X RAYS ON THE DAILY RHYTHM OF MITOSIS IN THE ROOT TIPS OF *VICIA FABA*. Shui Hao. K'o Hsueh T'ung Pao, No. 3, 55-6(1963).

Vicia faba seeds were soaked in water at room temperature for three days. The seeds were exposed to 10, 50, 100, 300, and 700 R of x rays at a dose rate of 71.4 R/min when the primary roots were just emerged through the seed coats. The irradiated and control seeds were germinated in wet sawdust. The root tips were fixed in Nawashin's fixative at different times during a period of 12-13 days after irradiation. The materials were embedded in paraffin, cut in serial sections, and stained with hematoxylin. The resting and dividing cells in definite region of the meristem were counted to determine the mitotic rate. In normal roots the mitotic indexes at hours 4, 8, 12, 16, 20, and 24 were 14.69 ± 0.825, 10.69 ± 0.551, 9.95 ± 0.373, 14.88 ± 0.493, 7.95 ± 0.455, and 7.13 ± 0.427%. It was obvious that there were two peaks of cell divisions (at 4 A.M. and 4 P.M.). In the irradiated roots the second peak appeared not at 4 in the afternoon but at midnight after receiving 10, 50, 100, and 300 R x irradiation or at 8 P.M. after 700 R x irradiation. In roots exposed to 10 R x rays the mitotic indexes at hours 4, 8, 12, 16, 20, and 24 were 19.99 ± 0.684, 14.60 ± 0.391, 13.04 ± 0.460, 8.29 ± 0.469, 7.21 ± 0.275, and 13.31 ± 0.574%. It is suggested that it is necessary to fix the materials at regular intervals during a period of 24 hours to determine the mitotic activity at some day after irradiation. (TCO)

8879 CHANGES OCCURRING IN THE GLYCOGEN CONTENT AND THE STRUCTURE OF GLYCOGEN MOLECULE OF THE LIVER UNDER THE INFLUENCE OF WHOLE-BODY IRRADIATION AND NITROGEN MUSTARD POISONING. Gábor Dávid, Dezsoe Tonka, and Alfréd Czuppon (Magyar Néphadsereg Egészségügyi Szolgálata, Budapest). Magy. Radiol., 16: 246-50(Aug. 1964). (In Hungarian)

Certain discrepancies in the literature indicate the need for further research into the changes in liver glycogen in radiation sickness and after treatment with radiomimetic substances. Tests were made on adult rats which received 800-R whole-body x irradiation (180 kv), or 1.7 mg/kg nitrogen mustard injected subcutaneously. Their livers were studied 24, 48, 120, and 240 hr after treatment. Two hr prior to death the animals received 3 ml/100 g body wt of 20% galactose solution. Half the livers were suspended in 10% neutral formalin, the other half in 96% alcohol saturated with glucose. The irradiated rats showed a decreased liver glycogen content as follows: after 24 hr 24% of the animals, after 48 hr, 48%, after 120 hr, 32%, after 240 hr, 28%. Following nitrogen mustard injection 12% of the animals showed decreased glycogen content after 24 hr, 56% after 48 hr, 60% after 120 hr, 8% after 240 hr. Histochemical tests showed that PAS-positive granules (glycogen) disappeared almost completely after 24 to 48 hr in both the irradiated and nitrogen mustard-treated rats in the formalin-fixed livers, but showed parallel results to the chemical analysis in the alcohol-fixed livers. It is concluded that nitrogen mustard caused glycogenolysis to appear more rapidly, reaching its maximum extent on the 4th to 6th day, but with normalization occurring on the 10th day, whereas the irradiation caused progressively increasing glycogenolysis and on the 10th day only ¾ of the animals showed normalized levels. Ultracentrifugal and viscosimetric measurements of glycogen in nitrogen mustard-treated animals showed similar results to those in radiation sickness in that the degree of polymerization of the liver glycogen dropped sharply. However, this drop was slightly more marked after irradiation. (BBB)

8880 THE SERUM MAGNESIUM PATTERN IN CANCER PATIENTS BEFORE AND AFTER TELECOBALT IRRADIATION. K. H. Gebhardt and W. Bohndorf (Universität, Wurzberg, Ger.). Med. Klin. (Munich), 58: 369-70 (Mar. 1, 1963). (In German)

The relation between serum Mg level and changes in blood Mr during and after treatment were studied in 27 carcinoma patients who received telecobalt treatment. Serum Mg was measured before and after the treatment, and also when half of the treatment had been administered. The dose rate was 50 rad/min measured in air. All patients received an average of between 5000 and 7000 R focal dose, administered over a time interval of from 30 to 50 days. The average Mg levels did not differ significantly before, after, or during the radiation treatments. They were not lowered significantly, compared to the average range found in 21 normal individuals. Most of the patients studied had bronchial carcinoma. There were two with brain tumors, one with Hodgkins disease, and one with a sarcoma. In only two of these cases was the normal distribution range of Mg concentration slightly exceeded. In an additional series of 20 malignant tumor cases, only one patient with a prostatic carcinoma with bone metastases showed an elevated serum Mg. Two of three metastatic mammary carcinoma patients had serum Mg levels in the upper region of the normal range. These studies did not indicate that there was any significant alteration of the serum Mg levels during high-level radiation therapy. (BBB)

8881 INVESTIGATIONS ON RADIATION AS A CAUSE OF DISEASE. L. Diethelm. Methods Inform. Med., 3: 78-83(Apr. 1964). (In German)

The instructive value of statistics on the pathogenic influences of radiation is discussed with reference to a number of special problems, such as the critical limit of lenticular injuries under the influence of age, dose level, and period of observation; the influence of a single or multiple mutation on a population; the relationship between radiation and the pathogenesis of leukemia, with reference to uncertainties in the evaluation of small doses of radiation; and the relationship between a lethal dose of radiation and the time of death. In comparison with these statistically demonstrable factors, it is shown on the basis of the response of the spleen to local and whole-body irradiation that this must involve, in addition to a trigger effect, humoral influences; for evaluation of the differences in effect observed, no possibilities other than statistical methods are available. It is pointed out that the normal ability of the spleen to destroy erythrocytes can be demonstrated with the aid of isotopes; in a way, this constitutes a statistical method, and radiation damage of the spleen can also be demonstrated in this way. Emphasis is placed on the necessity of including, in the evaluation of radiation as cause of disease, other noxae with a similar action. (auth)

8882 HISTOCHEMICAL STUDIES OF THE EFFECTS OF IONIZING RADIATIONS ON THE ENZYME REACTIONS OF THE SKIN OF THE GUINEA PIG. II. CHANGES IN α-NAPHTHYL AND TWEEN ESTERASES. L. Bruni and A. Mazza (Università, Pavia, Italy). Minerva Dermatol., 37: 134-9(Apr. 1962). (In Italian)

Earlier histochemical studies were continued to determine the changes induced by ionizing radiations in the enzyme activity of the skin. Four groups of guinea pigs received local doses of 500, 1000, 3500, and 5500 R of 60-kv x rays over a 3-cm dia area of dorsal skin. The Tween-60 esterase activity was increased in the malpighian layer, fibroblasts, mast cells, histiocytes, hair follicles, and sebaceous glands, and it was present in structures where it is normally non-existent: the horny, granular, and keratogenic layers and capillaries. α-Naphthyl esterase activity was increased in the malpighian layer, fibroblasts, mast cells, histiocytes, hair follicles, and sebaceous glands, and was present in the skin capillaries. As was previously noted in the case of the alkaline and acid phosphatase, the intensity of the activity of the α-naphthyl and Tween esterases was related to the x-ray dose used and to the time interval between irradiation and observation of the effects. (BBB)

8883 EFFECTS OF RADIATION ON THE SYNTHESIS OF NUCLEIC ACIDS IN POLYTENE CHROMOSOMES. Crodowaldo Pavan and Renato Basile (Univ. of Sao Paulo, Brazil). Natl. Cancer Inst. Monograph, No. 14, 199-204 (1963).

Experiments were done using larvae of Rhynchosciara angelae (Diptera, Sciaridae) to study the effect of ionizing radiation on the synthesis of deoxyribonucleic acid (DNA). Different groups of larvae were exposed to 1250, 2500, 10,000, and 20,000 Roentgens from a source of γ rays, and the effect of radiation on these chromosomes was analyzed. Autoradiography and tritiated thymidine were used as radioactive precursor to DNA. In cells of the salivary gland of R. angelae the radiation (even the 20,000 Roentgen dose) seemed to stimulate the synthesis of DNA, as shown by the many cells incorporating tritiated thymidine and also by the higher intensity of incorporation in chromosomes that received radiation as compared to nonirradiated controls. (P.C.H.)

8884 THE OXYGEN AFTER-EFFECT IN γ-IRRADIATION OF HAPLOID AND DIPLOID YEAST. E. M. Karabaev (Lomonosov State Univ., Moscow). Nauchn. Dokl. Vysshei Shkoly, Biol. Nauki, No. 1, 105-8(1962). (In Russian)

An attempt was made to determine the effects of oxygen on γ-irradiated yeast cells at 0 and 20°C. Irradiation of haploid yeast cells at 0° in N_2 with subsequent transfer to an atmosphere of N_2 and air at 20°C considerably increased survival, but transfer of irradiated diploid cells to N or air did not influence survival. Irradiation of either haploid or diploid cells at 20° with subsequent air or N treatment had no effect. It was assumed that reversible radiation damage to the cells becomes irreversible at 20°C. (R.V.J.)

8885 CHOLESTEROL METABOLISM IN THE ORGANS OF IRRADIATED RATS. M. F. Vinogradova (Leningrad State Univ.). Nauchn. Dokl. Vysshei Shkoly, Biol. Nauki, No. 1, 89-91(1964). (In Russian)

The cholesterol content of various organs was studied in rats following 48 hr exposure to 2000R. The liver, spleen, and blood of irradiated rats contained considerably more cholesterol than the organs of control animals. The cholesterol content in the brain and muscles of irradiated animals remained unchanged. (R.V.J.)

8886 EXPERIMENTAL STUDY ON NEUTRON INDUCED CATARACTS. II. CATARACTOGENIC DOSE OF FAST NEUTRONS IN RABBITS. Kanji Choshi (Hiroshima Univ.). Nippon Ganka Gakkai Zasshi, 67: 1896-1901(1963). (In Japanese)

The threshold dose of fast neutrons that will cause permanent damage to the crystalline lens of adult albino rabbits by irradiation with fast neutrons (14.1 Mev) was determined. In the low dose exposed groups ($2.5 \times 10^8 - 2.0 \times 10^9$ n/cm^2), the change in the lens was very slight. The opacities increased slightly following development, but then either remained unchanged or even decreased in some cases during the period of observation. In the medium dose exposed groups ($4.0 \times 10^9 - 1.6 \times 10^{10}$ n/cm^2), slight evidence of increase in opacity was noted, but after reaching a certain degree, the formation of opacity became stationary. It is assumed that permanent damage will result. In the high dose exposed groups ($3.2 \times 10^{10} - 9.6 \times 10^{10}$ n/cm^2), the degree of opacity was greater than in the medium dose exposed groups, and the change was such that diminishing of vision could be expected. Opacity showed a trend of gradual increase through the period of observation. However, there was not any case where total opacity developed. In experiments conducted on adult albino rabbits, it was assumed that the threshold dose of fast neutrons (14.1 Mev) that would produce permanent damage and where diminishing of vision could be expected, is 3.2×10^{10} n/cm^2 or less, and would be higher than that required for 10 weeks old rabbits. (P.C.H.)

8887 STUDIES ON RADIATION INJURY TO DOMESTIC ANIMALS BY RADIOACTIVE MATERIALS. I. EFFECT OF INTERNAL IRRADIATION ON THE CHICKEN BY P^{32}. [PART] 2. Osamu Matsuoka, Miyoshi Ikeda, and Yoshio Ohkubo (Tokyo Univ.). Nippon Juigaku Zasshi, 20: 241-51(1958). (In Japanese)

Studies were made on the internal irradiation effects of ^{32}P on chickens. As a result of single administration of doses beyond 3 μC/g, the chickens died; 80% died as the result of a dose of 5 μC/g and all died after doses of 10 μC/g. A curve on the rate of weight gain was inhibited according to the increase in the dosage of ^{32}P. For example, the inhibition was slight for a dose of 1 μC/g (minimum dose tested), while the body weight did not increase at all in the case of 10 μC/g (maximum dose tested). The spleen, thymus, and testicle decreased in weight, while the liver, kidney, and heart increased. Food intake was inhibited by doses beyond 5 μC/g, but water intake was not affected at any dose tested. In blood hemoglobin, the hematocrit value showed a remarkable decrease, and in some cases decreased to about 10% of the control value. An increased value of albumin was observed in the initial period after administration, and a durated increase of globulin was observed over a period of twenty days. Blood sugar after administration of ^{32}P gradually increased in the course of time. The glucose tolerance test showed delay of recovery on the curve of glucose tolerance curve. It was concluded the ^{32}P internal irradiation affected the hematogenic organ remarkably, while other organs were noticeably less affected. (P.C.H.)

8888 STUDIES ON RADIATION INJURY TO DOMESTIC·ANIMALS BY RADIOACTIVE MATERIALS. II. INJURY BY IRRADIATION OF P^{32} LOCALLY APPLIED TO THE DIGESTIVE SYSTEM. Osamu Matsuoka, Miyoshi Ikeda, and Yoshio Ohkubo (Tokyo Univ.). Nippon Juigaku Zasshi, 24: 135-40(1962). (In Japanese)

Studies were made on the radiation hazard of local irradiation applied to the digestive system of rats. ^{32}P, which had been wrapped with polyethylene film, was inserted into four places of the digestive system by surgical operation. These places were the abdominal subcutaneous tissue, abdominal cavity, liver, and small intestine. No remarkable change was caused in rats when the source was implanted into the abdominal subcutaneous tissue, even though the dose of isotope used for injection was a lethal one. Intraperitoneal implantation of the source, so as to cover the intestinal tract, gave rise to such typical symptoms as loss in body weight and diarrhea, causing death of all animals due to intestinal injury. In these animals, the effects of irradiation on general symptoms, blood picture, and organ weight were studied. The difference in the effects of irradiation between the two types of application, intraperitoneal injection and local implantation, is discussed. (auth)

8889 EFFECTS OF γ-IRRADIATION ON THE ACTIVITIES OF DIGESTIVE ENZYMES OF THE SILKWORM, BOMBYX MORI L. Toshio Ito and Motozo Tanaka (Agricultural Experiment Station, Tokyo). Nippon Sanshigaku Zasshi, 32: 330-7(Dec. 1963).

When newly molted fifth instar larvae of the silkworm, Bombyx mori L., were irradiated with ^{60}Co γ rays at dosages of 60 or 80 kR, invertase, β-glucosidase, and trehalase of the midgut as well as amylase and proteinase of the digestive juice were inhibited. The radiosensitivity varied according to enzymes. With acetone-dried midgut and lyophilized digestive juice, it was found that the rate of inhibition was highly related not only to the dosage of γ rays but also to the concentration of the enzyme solution employed. (auth)

8890 WITH REFERENCE TO THE INFLUENCE OF X-RAYS ON THE PROLIFERATION OF STEM-CELLS DEVELOPED FROM HUMAN LYMPHOCYTES. G. Astaldi, G. Costa, and R. Penna (Hospital of Tortona, Italy and University Hospital, Cordoba, Argentina). Nucl. Hematol., 4: iv-vi(Dec. 1964-Feb. 1965).

The influence of different x-ray doses on the proliferation of stem-cells developed in tissue cultures with Phytohemagglutinin from human blood lymphocytes was tested using the stathmokinetic test. It was found that 20 R doses is seriously inhibiting, whereas 40 R doses reduce the proliferative activity by a third, and 200 R doses reduce that activity to a third in respect to the control. Nevertheless, other cells of the hemopoietic series were more responsive to the x-ray inhibition than the above-mentioned stem-cells. (auth)

8891 X-RAY-PRODUCED SARCOMAS IN THE GUINEA PIG. A. Maggiora and J. Lilla (Université, Geneva). Oncologia, 18: 33-42(1964).

Results are reported on the effects of chronic irradiation of guinea pig skin. Doses of 100 R were applied to the right flank and 200 R to the left flank until death. The doses of 50-kv x rays were applied daily (6 days per week), over a skin area 3 cm in dia, in 34 animals. In sites irradiated with a daily dose of 100 R the fur was already sparse 50 to 70 days after the start of the experiment (4000 to 6000 R). Complete epilation was attained after widely varying time intervals (three and a half months to 6 months, i.e., doses of ~9000 to 15,000 R). All the animals presented erosions or small ulcers after 8 months (22,000 R). In sites irradiated with a daily dose of 200 R, thinned fur was seen from the 30th day (5200 R) to the 51st day (8400 R) of irradiation. Epilation was complete between the 40th (6400 R) and the 60th day (10,000 R). All the animals that survived showed deep ulcerations. The ulcers appeared at times varying between 45 days (7600 R) and 5 months (25,800 R). As the experiment continued, the ulcers became deeper and wider. Thus, a dose of 100 R/day provoked ulcers only exceptionally, but ulcer formation was the rule with a dose of 200 R. The results confirm the individual variability of guinea pigs to ionizing radiation effects. Two animals developed sarcomas after 11 and 12 months of irradiation (56,400, and 60,000 R, respectively); one showed a typical histologic picture of a rhabdomyosarcoma. The other tumor also appeared to originate from muscle cells. (TCO)

8892 MORPHOLOGIC CHANGES IN THE THYROID OF RATS TREATED WITH IONIZING RADIATION. Z. Lewicki (Institute of Experimental Pathology, Polish Academy of Sciences, Warsaw). Polish Med. J., 3: 279-86(1964). (OTS-64-11409/2). Translated from Patol. Polska, 14: No. No. 1, Suppl. (1963).

Seventy-five Wistar rats were x irradiated with a sublethal dose of 500 R or a lethal one of 900 R. The thyroid glands of these rats were examined microscopically. The changes consisted in vacuolization and degeneration of thyroid epithelium. Some cells or groups of them became necrotic and desquamated into the acinar lumen. These changes developed during the first ten days after the irradiation. In the second and third week the regenerative and hyperplastic processes predominated resulting in the restitution of normal thyroid structure. (auth)

8893 OCCUPATIONAL DISEASES DUE TO IONISING RADIATION. A. Bourguignon. Presse Med., 71: 2306-8 (Nov. 16, 1963).

A review of basic concepts in physics and radiobiology, with the industrial and scientific application of ionizing radiation, is given. Distinction is made between two types of occupational disease: acute irradiation as the result of an accident, and chronic irradiation with localized manifestations: skin lesions, mucous and ocular lesions, blood lesions, mucous and ocular lesions, blood lesions, cancer of the lung, bone lesions, and gonad lesions. Information on treatment, technical and medical preventive measures, and the French statutory provisions are given. (Occupational Safety Health Abstr., 2: No. 5, 1964)

8894 PRODUCTION OF TETRAPLOID MUSCADINE (V. ROTUNDIFOLIA) GRAPES BY GAMMA RADIATION. B. O. Fry (Georgia. Univ., Experiment. Georgia Experiment Station). Proc. Am. Soc. Hort. Sci., 83: 388-94(1963).

Experiments were conducted to determine the effects of different intensities and total dosages of gamma radiation on the production of tetraploid muscadine grapes. Doubling of the chromosome number in the muscadine was induced by treating vigorous growing lateral buds with gamma rays emitted from a ^{60}Co source. Intensities of approximately 175 R/hr and total dosages between 2350 and 4350 Roentgens were found best for inducing tetraploidy in growing muscadine plants. Pruning and fertilizing plants several days prior to radiation promoted cell division that resulted in greater cellular changes during treatment. Irradiating the cell during these changes resulted in the production of a larger number of tetraploid cells. Terminal growth was found to be more sensitive to radiation than the older lateral buds. The tetraploid plants obtained had a diploid epidermis and tetraploid internal tissue, larger, thicker, and darker leaves, greater cane diameter with shorter nodes, and larger pollen, seed, and fruit size than diploid plants of the same variety. The tetraploid buds began growth 4 to 6 days earlier each spring than diploid buds on the same plant or those of the control. The fruit ripened 10 to 15 days earlier. (P.C.H.)

8895 PRELIMINARY TRIALS OF GAMMA RADIATION ON MATURE GREEN IRWIN AND SENSATION MANGOS. T. T. Hatton, Jr., L. Beraha, and W. R. Wright (Dept. of Agriculture, Chicago). Proc. Florida Mango Forum, 21: 15-17(June 1961).

Studies were conducted to determine the effects of γ radiation on the market life of mangos, the rate of ripening of the fruits, and the control of anthracnose decay. Mature hard mangos of the Irwin and Sensation varieties were collected from groves in Dade County, Florida, and shipped by air mail to Chicago, where they were subjected to 10,000 to 200,000 Rad γ radiation. In most cases, irradiated fruits were slower to ripen than non-irradiated fruits, the greater the radiation dose, the longer the delay in ripening. A 10,000-Rad dose delayed ripening of Irwin mangos two weeks but a 15,000-Rad dose did not delay the ripening of Sensation mangos. These doses had no adverse effects on the flavor of the fruits. A 25,000-Rad dose did not delay ripening of Irwin mangos more than a 10,000-Rad dose. A 25,000-Rad dose delayed ripening of Sensation mangos three days. Palatability of fruits of both varieties was impaired by a 25,000-Rad dose. A 50,000-Rad dose delayed ripening of Irwin mangos three days longer than a 25,000-Rad dose, did not further delay ripening of Sensation fruits, and impaired flavor of both varieties of fruit. Nineteen days after 100,000- and 200,000-Rad treatments, Irwin mangos were still hard and green, but these fruits were severely shrivelled. A 100,000-Rad dose did not delay ripening of Sensation mangos more than 25,000- and 50,000-Rad doses but impaired the flavor of the fruits. Twelve days after a 200,000-Rad dose, Sensation mangos were still hard and green, and because they were slightly shrivelled, they were discarded. Observations of radiation effects on anthracnose decay were erratic and inconclusive, but it appeared that the degree of infection and development of lesions was dependent on dose. At lower doses there was some delay in lesion advance; at higher doses almost no development. For example, on soft untreated fruits of both varieties, the extent of decay ranged from moderate to severe. In the case of treated fruits of both varieties, including softened fruits as well as hard shrivelled fruits which were discarded, the extent of decay ranged from pinpoint to severe in fruits irradiated with 10,000- and 15,000-Rad doses; from slight to moderate in fruits irradiated with the 25,000-Rad dose; from pinpoint to severe with the 50,000-Rad dose; from pinpoint to slight with the 100,000-Rad dose, and only pinpoint with the 200,000-Rad dose. It appears likely that anthracnose development is somewhat dependent on the ripeness of the fruits, and radiation influences the fungus indirectly through its effect on rate of ripening. Considering previous results with other host materials infected with anthracnose, the doses of radiation used are well below the inhibiting or lethal range; consequently 200,000 Rad would not kill the anthracnose, especially in the host. (BBB)

8896 LEUKEMIAS IN HIROSHIMA DURING THE YEARS FROM 1946 TO 1961. S. Watanabe (Hiroshima Univ.). Proc. Intern. Congr. Hematol., 9th, Mexico City, 1962, 1: 499-510(1964).

A survey was made on the incidence of leukemia in the population of Hiroshima from 1946 to 1961. The incidence in individuals exposed to radiation from the 1945 atomic bomb explosion at various distances from the epicenter and among individuals who entered the city shortly after the explosion is compared with the incidence in other residents of Hiroshima and in the population of Japan. During the 16-yr period, 270 cases of leukemia occurred in Hiroshima, of which 174 were among exposed individuals. Based on 100,000/year gross population, the incidence of leukemia in the whole population was 4.96% and that in exposed individuals was 11.20%. The total number of deaths attributed to leukemia was 247, of which 159 had a history of radiation exposure. Myelogenous leukemia was the type most common in exposed individuals and only 2 cases were definitely diagnosed as lymphoid type. Data are summarized on the time of diagnosis of leukemia, rate of leukemia in various population segments, type of leukemia, and death rate of exposed and non-exposed individuals. (25 references.) (C.H.)

8897 LEUKEMIA IN RADIOLOGICAL WORKERS AND IN PATIENTS TREATED WITH IRRADIATION. G. Wakisaka, M. Yoneda, H. Uchino, H. Miyata, and H. Enomoto (Kyoto Univ. and Japan Red Cross Central Hospital, Tokyo). Proc. Intern. Congr. Hematol., 9th, Mexico City, 1962, 1: 511-21(1964).

A survey was made on the incidence of leukemia in persons in Japan occupationally or therapeutically exposed to radiation during the past 30 years. Questionnaires were sent to 1606 hospitals and cases of leukemia were examined for a history of radiation exposure. Among radiological workers, 16 cases of leukemia were found, with the age at diagnosis ranging from 24 to 57 years. They consisted of 6 physicians, 3 nurses, 6 technicians, and 1 physicist. They had engaged in x ray treatment or diagnosis for various periods ranging from 7 mo to 36 yr, with most exposed to intermittent partial x irradiation for more than 6 yr. There were 6 cases of acute myeloblastic, 1 case of acute lymphoblastic, 2 cases of monocytic, and 7 cases of chronic myelocytic leukemia. Twenty-five cases of leukemia were found in patients treated with radiation, with an age range of 16 to 62 yr, with most cases being in the older age group. More than 50% of the cases had received radiotherapy for malignant tumors. Sixteen cases had been exposed to x radiation, 3 to radium, 2 to a combination of x radiation and radium, and 1 to ^{60}Co γ radiation, while the type of radiation exposure of 3 cases was unknown. The total dose of x or γ radiation ranged from 1,000 R to 2,000 R, and the irradiation was administered over a period of time ranging from 7 days to 6 yr. The latent period between the initiation of irradiation and onset of leukemia ranged from 2 mo to 28 yr, but was less than 7 yr in 80% of the total cases. There was no correlation between the latent period and the total dose of irradiation. There were 17 cases of acute myeloblastic leukemia, 4 cases of monocytic, 2 cases of chronic myelocytic, and 2 cases of erythroleukemia. There was no case of lymphocytic leukemia. Records of postmortem examinations were available for 17 cases out of 41 cases of leukemia in radiological workers and patients treated with irradiation. Comparison of the data on leukemia incidence in radiological workers and the general population of Japan shows that the incidence in radiological workers is approximately twice that of the general population. (15 references.) (C.H.)

8898 INTERRUPTION OF SV$_{40}$ VIRUS TUMORIGENESIS USING IRRADIATED HOMOLOGOUS TUMOR ANTIGEN. H. Goldner, A. J. Girardi, V. M. Larson, and M. R. Hilleman (Merck Inst. for Therapeutic Research, West Point, Penna.). Proc. Soc. Exptl. Biol. Med., 117: 851-7(Dec. 1964).

X irradiated SV$_{40}$ transplant tumor or cell culture antigens were found to be highly effective in preventing occurrence of homologous tumor in hamsters inoculated with SV$_{40}$ virus when newborn. The x irradiated immunizing tumor antigen was effective when given in a single dose as early as 34 days or as late as 76 days after SV$_{40}$ virus was administered. The immunizing antigen was retained in tumor transplants in hamsters for at least 20 passages and in cell culture of tumor for at least 38 passages. The significance of the findings in relation to protection against the hypothetical virus-induced tumor in man is discussed. (auth)

8899 SPARING EFFECT OF X-RAYS FOR MICE INOCULATED INTRANASALLY WITH EGG-ADOPTED

INFLUENZA VIRUS, CAM STRAIN. Byron S. Berlin (Univ. of Michigan. Ann Arbor). Proc. Soc. Exptl. Biol. Med., 117: 864-9(Dec. 1964).

Pretreatment with x rays by whole-body exposure to 350 R delayed the time of death and reduced the number of deaths in mice resulting from intranasal inoculation of large doses of egg-passaged CAM strain influenza virus. The decreased mortality seemed to be due to a reduction in the frequency with which toxic pneumonitis developed after inoculation of virus since the radiation did not change the case fatality rate. The most likely explanation for the sparing effect is that pretreatment with x rays prevented a severe inflammatory response to the injury caused by a toxic principle associated with the virus. (auth)

8900 RELATIONS BETWEEN THE DOSE OF X-RAYS APPLIED AND THE RATE OF CYTOPLASMIC STREAMING IN NITELLA FLEXILIS. Claude Gillet (Universite, Liege). Protoplasma, 58: 286-93(1964). (In French)

Protoplasmic streaming of internodal cells of Nitella flexilis was found to be a particularly radioresistant phenomenon. Large doses of x radiation were necessary to reduce the rate of streaming and 800 KR was required to stop it completely. The streaming was regular in movement even in heavily irradiated cells and restoration to normal was observed immediately after irradiation was stopped. (C.H.)

8901 CUTANEOUS ALTERATIONS BY IRRADIATION. I. ULTRACELLULAR MODIFICATIONS OF THE HUMAN EPIDERMIS IN THE FIRST STAGE OF REACTIONS OF X OR BETA RADIATION. G. Poggi Longostrevi and A. Squassabia. Radiobiol. Latina, 6: 415-80(Oct.-Dec. 1963). (In Italian)

The modifications of the skin of the breast in patients having been treated one to six days before radical mastectomy with beta rays (^{90}Sr) to x rays (plesiotherapy) with doses of 1000, 3000, 4000 R of x rays or rep of beta rays given in one single treatment were investigated with the electron microscope. The alterations observed show an increase of the intercellular space, modifications of the digitations of the cellular membrane, which appear to be thinned, interrupted and irregular without any alteration of the structure of desmosomes; however, the latter, due to the intercellular edema lose their normal relationships with the cellular digitations and are grouped together. The basal membrane appears to be irregular in its dermic part, whereas the plasmatic part loses the aspects of a dotted line and appears to be frequently interrupted, thus allowing for the penetration of extraepidermic cells some four days after irradiation. Further, alterations are found of the cellular cytoplasm such as the appearance of small granules which are often grouped together and which are found in close topographic relationship with the tonofibrils, particularly so in the upper layers of the skin. Tonofilaments forming the tonofibrils are generally well evident even in the spinous layer, a finding which is not present in the normal. In the granular layer and in the spinous layer round osmiophile bodies are sometimes found which are similar to those observed by others in the hyperplastic skin. The alterations of tonofibrillar morphology and their relationships with granular formations are discussed both basing upon the classical mechanisms of radiobiological interaction and upon a possible alteration of keratinization, as suggested by Brodys researches on experimental animals. (auth)

8902 CUTANEOUS ALTERATIONS BY IRRADIATION. II. ULTRACELLULAR MODIFICATIONS OF THE HUMAN EPIDERMIS IN STAGES OF THE LATE REACTIONS OF X RADIATION. G. Poggi Longostrevi and A. Squassabia. Radiobiol. Latina, 6: 481-95(Oct.-Dec. 1963). (In Italian)

The infrastructural modifications of the human skin after x ray irradiation with a dosage of 6000 R were investigated. The alterations consist in modifications of the intracellular elements of the basal and spinous layer: both show the presence of numerous tonofilaments and irregular vacuoli, swollen mitochondria still preserving their crests and granules of melanine. In the spinous layer rounded corpuscles are found in large numbers. There are no modifications of the surfaces and of the intercellular spaces and the desmosomes are quite evident. The granular layer shows alterations of the morphology of the masses of keratohyaline. The horny layer is quite hyperkeratotic and quantitative as well as qualitative alterations of the three layers (basal, intermediate and apical) which compose it are to be found. (auth)

8903 INFLUENCE OF IONIZING RADIATION AND THE EFFECTS OF CORTISONE ON DENTAL TRAUMA OF THE ORAL MUCOSA OF RATS (RESEARCH CARRIED OUT WITH THE HELP OF ^{32}P). G. Gasso, G. Sortino, R. Rasà, and A. Garaffo (Università, Catania, Italy). Radiobiol. Latina, 6: 521-34(Oct.-Dec. 1963). (In Italian)

The possible influence exerted by ionizing radiations, alone or in association with intramuscular cortisone treatment, on the effects produced by dental traumatism on the oral mucosa of the rat following resection of the incisor teeth was investigated. The research is based upon the evaluation of the weight curve, of the histological and macroscopical aspects, and of the specific activity of ^{32}P injected through cardiocentesis by the tissues considered. From the results obtained it is assumed that the resection of the incisor teeth by itself cannot lead to any severe lesions, which are conversely found after association with panirradiation or with prednisone treatment. Localized irradiation of the chin region shows a marked opposite effect. It was further observed that prednisone treatment accumulates its effects with panirradiation but is antithetic if associated with localized irradiation. (auth)

8904 EFFECTS OF SOME INHIBITORS ON THE CATALASE OF CULTURES OF IRRADIATED HUMAN AMNIOTIC CELLS. II. MORPHOLOGICAL STUDIES. G. Poggi Longostrevi, A. Squassabia, and T. Zavanella (Università, Milan). Radiobiol. Latina, 6: 535-66(Oct.-Dec. 1963). (In Italian)

A morphological investigation was performed on cultures of human amniotic cells of the stabilized FL strain that were irradiated and pre-treated with some inhibitors of the catalase (hydroxylamine, sodium azide and hydrazide of the isonicotinic acid). The mitotic index, the cariocynetic histogram, and the microscopic aspect of resting cells were evaluated. The results show the radiosensibilizing action of hydroxylamine, the lack of effect of hydrazide of the isonicotinic acid and the lack of uniformity of the behavior of sodium azide. (auth)

8905 LOCAL RADIATION INJURIES—CAUSES AND SEQUELAE. E. G. Mayer (Universität, Vienna). Radiol. Austriaca, 14: 3-27(1963). (In German)

Even though they are not mentioned so much nowadays, local injuries to the skin from radiation continue to occur, whether they result from treatment of tumors or not. Some are the result of diagnostic x ray, but the greater number is the result of treatment of definite sicknesses. Often skin injuries are caused by summation of continued small exposures to radiation, resulting in definite skin damage. Many of these injuries could be avoided without any lessening of the medical effects of the radiation. Sometimes the patient fails to inform the radiologist of prior courses of irradiation that he has undergone. In some, infrequent instances the radiologist's assistant is required to attend to so many other duties that the patient is neglected, even while he is under the x-ray tube. Operative procedures should not be conducted in skin areas that have been irradiated, since healing is delayed or ulceration can develop. There does not seem to be any valid evidence for increased susceptibility or sensitization to radiation. Most cases that are reported to result from some increased radiation sensitivity can generally be explained on the basis of other factors that are unrelated to the possible effects of the radiation. Sometimes the dose recorded as having been administered may disagree with the dose actually administered. In some older patients who have an extended history of irradiation it may be found that early procedures had been followed which since then have been found to be erroneous. A frequent error that appeared in some earlier radiation procedures was too frequent exposure, without a sufficient time interval between consecutive radiation treatments. Not the least as a cause of unnecessary irradiation is mistaken diagnosis on the part of the physician. Some of these instances are recognized, but not all can be detected and recognized early enough to be effective in saving the patient's life. (BBB)

8906 ON THE QUESTION OF THE EFFECT OF SPLENECTOMY ON A SUBSEQUENT SUBLETHAL WHOLE-BODY IRRADIATION. R. Fridrich (Universität, Basel). Radiol. Austriaca, 14: 77-81(1963). (In German)

Spleens were removed from 150 male albino mice of a commercial inbred strain under intraperitoneal narcosis. A section of fatty connective tissue was removed from the omenta of 160 similar mice. Groups of 18 to 27 operated animals were irradiated with 650 R of whole-body x radiation at a rate of 77 R/min one to 60 hr later. For controls 39 nonoperated animals were exposed to the same amount of whole-body radiation. The results did not indicate that the spleen had any specific reparative effect on radiation injury of blood-forming organs, because the survival time of mice that had been omentectomized prior to exposure to sublethal whole-body radiation was not different from the survival time of splenectomized mice. The effects of splenectomy are nonspecific. The question whether the rather low lethal effect of whole-body radiation after splenectomy or omentectomy is due to a stress reaction produced by activation of the hypophyseal adrenal system is undecided. The fact that the interval between operation and irradiation must not be greater than 24 hr in order to decrease mortality suggests that a stress reaction is involved, because it is known that this type of reaction decreases with time. Removal of the spleen prior to the radiation result probably produces only a nonspecific operational stimulus. It was not possible to designate any alteration of bone marrow function or any accelerated, early onset of regeneration as a specific result of splenectomy. (BBB)

8907 A SIMPLE METHOD FOR REDUCTION OF GONADAL BURDEN DURING PHOTOGRAPHY OF THE LUMBAR VERTEBRAL COLUMN. K.-H. Michalk (Chirurgische Universitatsklinik, Rostock, Ger.). Radiol. Diagn., 2: 123-6(Aug. 1961). (In German)

A shield with a Pb window that results in improved picture quality in radiography of the lumbar vertebral column, and reduces the radiation exposure of the gonads has been designed. When inserted between the x-ray tube shield and the point of insertion of the tube, in a crosswise direction, this shield permits rectangular films to be obtained from round x-ray tubes. The shield consists of a Pb plate, 1.8 mm thick, with a length on edge of 110 mm and a centrally located square window. A handle to facilitate manipulation of the shield projects to one side. The dimensions of the Pb window are variable, and can be calculated from simple geometric formulae. These take into account the distance between the focus and the film, and the distance between the focus and the Pb window. To measure the radiation dose at the surface of the scrotum when photographs of the lumbar vertebral column were taken, studies were made with film dosimeters. Radiograms of the lumbar column were taken sagitally with 75-kv, 200-ma x ray, and in a frontal direction with 90-kv, 250-ma x ray. Measurements were made with and without a tube, with the tube and the Pb window, with a tube and a Pb shield over the testis, with and without the Pb window. The round tube used had a dia of 17.5 cm. The Pb rubber plates that were used to shield the testis were 3.7 mm thick, corresponding to a Pb equivalent of 1.22 mm. At the two x-ray voltages used, the irradiation dose of the scrotum was over 200 mr without the round tube. With the tube it was 120 and 75 mr. With the round tube and the Pb window it was 50 and 35 mr. With the round tube and the Pb shield over the testis the exposure was 10 and 8 mr. With the combination of round tube, Pb shield over the testis, and the newly developed Pb window the radiation exposure was so small that it could not be recorded on the dosimeters. (BBB)

8908 CHANGES IN CONSTITUENTS OF SERUM OF MICE AFTER LETHAL IRRADIATION. P. Grabar, K. P. Kashkin, and J. Courcon (Institut Pasteur, Paris). Rev. Franc. Etudes Clin. Biol., 8: 565-9(June-July 1963). (In French)

Electrophoretic and immunoelectrophoretic analysis was made of sera of mice irradiated by a lethal dose (1000 R) of 200-kv x rays. Ten groups of mice were studied. They were bled at daily intervals after irradiation. A decrease was noted in the content of several proteins in the blood serum. Changes noted in globulins are described. (BBB)

8909 TESTS OF SENSITIZATION WITH 6-MERCAPTOPURINE, WITH OR WITHOUT 5-BROMODEOXYURIDINE, ON THE EFFECTS OF IRRADIATION ON ALLOGENIC SKIN GRAFTS. Homai Da Costa, Rose Tenenbaum, and Anne Marie Mery (Hopital Saint-Louis, Paris). Rev. Franc. Etudes Clin. Biol., 9: 90-3(1964). (In French)

Whole-body irradiation of mice with 400 rad doses of x radiation did not prolong the survival of allogenic skin grafts. Conditioning by irradiation before grafting together with intraperitoneal injections of 6-mercaptopurine or 5-bromodesoxyuridine prolonged graft survival longer than irradiation alone. (C.H.)

8910 NEW CONCEPTS OF THE GENETIC AND CYTOLOGIC EFFECTS OF RADIATION. Benedetto Nicoletti (Università, Rome). Riv. Biol., 56: 267-307(July-Sept. 1963). (In Italian and English)

Recent data concerning the early events of radiation injury of cellular constituents are reviewed. Although an essentially physical nature was attributed to the mechanisms by which radiation causes biological effects, today it is recognized that the complexity of the interactions between radiant energy and living matter is such that the target theory no longer explains all the facts completely. Present knowledge about the relation between the intensity with which a dose of radiation is administered and the frequency of the mutation induced is discussed. From these considerations the degree of dose-rate dependence seems to be closely related to the sensitivity of the cell to the killing effect of radiation, although the repair process may play a crucial role in both phenomena. Various experiments are referred to which lead to the conclusion that many types of cells show an increased radioresistance corresponding to mitotic stage. The diversity of both cell material and nature of damage may account for these reported differences. It was concluded that radiation damage results from complex interactions that are difficult to trace to one simple mechanism. (TCO)

8911 URINARY CORTICOSTEROID EXCRETION IN HYPERTHYROID SUBJECTS SUBMITTING TO RADIOACTIVE IODINE THERAPY. V. Righi (Ospedale Civile, Ostiglia, Italy). Riv. Patol. Clin., 17: 694-702(1962). (In Italian)

Seven subjects were studied who were treated orally with ^{131}I with a dose fractionated over a 2-month interval. Before and after radioiodine therapy the basal metabolic rate (BMR) and urinary corticosteroid secretion were measured. According to subject, the elapsed period between the last administered dosage of radioiodine varied from two to five yr. The urinary formaldehydogenic corticosteroids were determined according to the Rivoire and Paskowski method and aldosterone according to the physiochemical method of Neher and Wettstein. In subjects suffering from a mild form of hyperthyroidism, on the basis of clinical investigation and hyperthyroidism, on the basis of clinical investigation and BMR, the formaldehydogenic corticosteroid and aldosterone levels were within the normal limits. This was noted both before and after the ^{131}I therapy. In subjects suffering from severe hyperthyroidism before the radioiodine therapy a very elevated level of formaldehydogenic corticosteroids was found. This finding demonstrates that the adrenal corticoid activity is increased in relation to the hyperthyroid condition. After recovery and a period of five yr after the administration of ^{131}I, the urinary formaldehydogenic corticosteroid secretion returned to within its normal level. This demonstrates that the improvement of the hyperthyroid condition, and thus the decrease of the thyroid hormone tissue level, eliminates the necessity for the gland to increase the supply of the glucocorticoid hormones. The adrenal cortex returned to a state of relative functional rest along with the regression of the thyroid hyperplasia that occurs in hyperthyroid subjects. On the contrary, the urinary aldosterone secretion is maintained at a normal level both before and after the ^{131}I therapy. It appears that even a severe hyperthyroid state, as well as its disappearance caused by radioiodine, does not have any effect on the aldosteronuria. It is concluded that formaldehydogenic steroid excretion decreases to normal after successful treatment of severe hyperthyroidism, whereas aldosteronuria remains normal before and after ^{131}I treatment. (BBB)

8912 QUALITATIVE CHANGES IN OXIDATION-REDUCTION PROCESSES DURING GAMMA IRRADIATION. V. V. Barbarin and V. A. Kostromskaya. Sb. Tr. Sverdlovsk. Gos. Med. Inst., 39: 11-18(1963).

In experiments on northern hydra (Pelmatohydra oligactis), maintained in laboratory cultures, and southern hydra (without laboratory cultivation), the qualitative characteristics of the intracellular respiration during the development of radiation injury caused by γ-irradiation in lethal doses was studied. The lethal doses for the northern and southern strain were 750 to 1000 and 4000 R, respectively. The differences in the reaction of the northern and southern strains of hydra are conditioned by the characteristics of the oxidation-reduction processes, multiform individual and phasic characteristics of their metabolism and vital activity at various moments of ontogenesis, and certain characteristic results of qualitative and quantitative changes in oxidation-reduction processes during radiation sickness. For lower multicellular animals, a decreased need for O_2 in the first few hours after irradiation, a possible increase in the intensity of respiration in the early period of injury, and a relatively greater stability of the cyanide-resistant oxidation-reduction chain are characteristic. (auth)

8913 THYROID CARCINOMA IN CHILDHOOD AFTER X IRRADIATION OF A VASCULAR CUTANEOUS NEVUS TWELVE YEARS PREVIOUS. K. Brunner (Universität, Zurich). Schweiz. Med. Wochschr., 91: 389-94(Apr. 1, 1961). (In German)

This report concerns a 13-yr-old girl who, 12 yr after radiation therapy as a 6-month-old infant for multiple cavernous and tuberous skin hemangiomas of the face, neck, and thorax, developed carcinoma of the thyroid gland. The minimal field dose of radiation was as follows: 800 R of soft 12-kv x radiation, 800 R of supplementary radiation with the Chaoul apparatus, and 612 R of Ra. The maximal field dose was: supplementary radiation of five times 400 R = 2000 R with the Chaoul apparatus or 3520 R of Ra + 1800 R of 12-kv x radiation. About 1 yr following the surgical excision of the tumor, a nodular local recurrence with metastasis to a solitary regional lymph node occurred, both of which were easily removed surgically. At present the patient is without signs or symptoms of further metastasis. The possibility of radiation-induced thyroid carcinoma in children is discussed on the basis of several reports and statistical compilations. A survey of the literature shows that the latent period for thyroid cancer in children after previous radiotherapy ranges from three to 10 yr, with an average of 6.9 yr. It is suggested that treatment of facial hemangiomas in childhood should be conducted with β radiation such as obtained with a ^{90}Sr applicator, so that the thyroid gland is not irradiated. (BBB)

8914 ON THE EFFECT OF IRRADIATED PANTOTHENIC ACID ON THE BLOOD. III. COMPLEMENT DETERMINATION AND DISCUSSION OF RESULTS. W. A. Ritschel. Sci. Pharm., 31: 221-30(1963). (In German)

Sodium pantothenate or its alcohol, preirradiated with α or β radiation increases the complement titer of sheep blood more than unirradiated pantothenic acid preparations. Irradiation with β particles had a greater effect in increasing complement titer than did α irradiation. The effects of the Na salt were ~ twice as great as those of the alcohol. The complement titer was increased by the alcohol of pantothenic acid from 13.27 to 13.63 units. Compared to this, α irradiated pantothenol increased the titer from 14.63 to 17.85, and β-irradiated pantothenol increased the titer from 27.52 to 49.30 units. These represent increases of 2.71, 22.09, and 49.30%, respectively. Sodium pantothenate increased the titer from 22.72 to 24.39 units. After irradiation with α particles the titer increased from 18.51 to 28.57 units. After irradiation with β particles the titer was increased from 16.57 to 30.00 units. These increases amounted to 7.35, 54.34, and 85.87%, respectively. Because antibody formation increases along with increased complement titer, it could be increased by administration of irradiated pantothenic acid. This could be advantageous in immunization against infection. (BBB)

8915 RADIATION BREEDING IN TWO-ROWED BARLEY. Takumi Tsuchiya (Kihara Inst. for Biological Research, Yokohama). Seiken Jiho, 14: 21-34(Dec. 1962).

Results obtained in radiation breeding experiments on two-rowed brewing barley are described. The total number of selected viable mutations was 289 from 4,971 X_1 spikes tested in X_2 generation. The 289 viable mutations include various types such as short culm, short spike, short awn, early, slender, lax spike, male sterility, and others. Descriptions are given of some of the outstanding mutants examined. (P.C.H.)

8916 RUPTURE BY X RAY OF THE HYDROGEN BONDS OF DEOXYRIBONUCLEIC ACID IN RAT'S THYMUS AND SPLEEN IN VIVO. Pao-fun Cheng, Won-kan Dao, Shao-ping pan, and Yung-teh Sze. Sheng Wu Hua Hseuh Yu Sheng Wu Wu Li Hsueh Pao, 3: 301-11(1963).

Two hundred and fifty-three white rats were divided into sixteen groups, four of which served as controls and the rest were irradiated with x rays at a dosage of 1000 Roentgens. DNA was extracted from the spleen and the thymus of the decapitated experimental animals. The extracted nucleic acid was carefully examined and was found to have little or no denaturation. After 1000 R whole-body x irradiation changes were observed in the intrinsic viscosity, the electrometric titration curve and ΔE% of the thymus and the spleen DNA of the rat. These were taken as evidences for the rupture of the hydrogen bonds resulting in partial destruction of the secondary structure of the DNA molecules in the radiosensitive tissues examined. (TCO)

8917 EFFECT OF IONIZING RADIATION ON THE STIMULATING PROPERTIES OF TISSUE EXTRACTS. G. D. Tumanishvili, V. P. Mandzhgaladze, and Kh. N. Dzhanelidze. Soobshch. Akad. Nauk Gruz. SSR, 33: 549-56(1964).

Experiments were conducted on frogs (Rana ridibunda) injected intraperitoneally with 0.4 ml of chicken liver and frog liver extracts irradiated with a 1000 R dose by means of an x-ray apparatus. The injections were administered immediately after surgical removal of a section of the liver. The amount of nucleic acid (DNA and RNA) was determined within 12-96 hours after perfusion of the frogs with 0.14M NaCl. The values obtained (divided by the number of nuclei counted under a microscope) were used to gauge the dynamics of stimulation. It was found that irradiated chicken liver extract had a more pronounced and earlier stimulating effect on the synthesis of nucleic acids than the native extract. Evidence points to the fact that the stimulation by irradiated liver extracts tends to preserve a constant DNA concentration. (OTS)

8918 ON THE INFLUENCING OF THE RESORPTION OF INTRACUTANEOUS AND INTRAMUSCULAR RADIOACTIVELY LABELED DEPOSITS BY WEAK X-RAY IRRADIATION. Gerhart Alth, Adolf Mostbeck, Rudolf Pape, and Hanns Siedek (Wilhelminenspitals, Vienna). Strahlentherapie. 125: 524-35(Dec. 1964). (In German)

The resorption velocity of intramuscular and intracutaneous deposits of ^{131}I in distilled water, in physiological saline, and in 3% saline solutions was investigated in 68 cases prior to and after x irradiation with 2 R SD. One third of the cases showed a resorption increase immediately after irradiation, only if deficient circulation and a local irritation caused by an anisotonic solution, occurred concurrently. In single cases, weak x irradiation of the lumbar sympathetic nerve caused an immediate reaction in the corresponding dermatoma. The effect caused by irradiation with 2 R was stronger than that caused by hyaluronidase, and was due to a neurovascular event. Colloid substances (^{198}Au) were not absorbed for 45 min after weak x irradiation. The effect in the altered tissue might be interpreted as a normalizing reaction. (auth)

8919 THE CHANGES IN THE ISOENZYME OF LACTATE DEHYDROGENASE AFTER ACTION OF IONIZING RADIATION. PART I. THE BEHAVIOR OF THE ISOENZYME OF LDH IN SERUM AND TISSUE HOMOGENATES OF WHOLE-BODY IRRADIATED RATS. Karl Heinz Kaercher and Helena Toshi Kato (Universitäts-Strahlenklinik, Heidelberg). Strahlentherapie, 125: 548-66(Dec. 1964). (In German)

The biochemical behavior of the irradiated cell and reasons for investigating enzyme activities in serum and tissue are discussed. Different methods for determining the isoenzymes of the enzymes are discussed; the agar-gel-eleotrophoresis of the LDH-isoenzyme is reported in detail. The reliability of the results was confirmed by comparing them with the ones obtained with the high voltage electrophoresis. It is especially pointed out that the time course of the total LDH-activities in serum and organ homogenate cannot give information about the radiosensitivity of single tissues after a single whole-body irradiation. However, examination of the isoenzyme pattern of single organs can give valuable hints. (P.C.H.)

8920 THE EFFECTS OF METHYL CELLULOSE ACCUMULATION ON THE SURVIVAL TIME OF MICE IN WHOLE-BODY X-RAY IRRADIATION. Erwin Soevényi, Ferenc László, and Alexander Benkoe (Univ. of Szeged). Strahlentherapie, 125: 582-7(Dec. 1964). (In German)

Methyl cellulose, given in single or continuous doses, had an unfavorable effect on the mortality rate of mice that had received sublethal whole-body x irradiation. Histological investigations showed that radiation did not change the incorporating ability of the RES. The regenerating ability of the hematopoietic system was damaged to a greater extent in the animal treated with methyl cellulose than in the ones that were not treated with methyl cellulose. (auth)

8921 EFFECT OF HIGH DOSAGE OF ^{60}Co GAMMA RAYS ON GAMMA AMINOBUTYRIC AND GLUTAMIC ACID CONTENT IN BRAIN TISSUE IN MICE. Milan Jovanovic and Nadezda Svecenski (Institut za Nuklearne Nauke "Boris Kidric," Belgrade). Strahlentherapie, 125: 588-90(Dec. 1964).

In mice irradiated with 1200 R of ^{60}Co gamma rays, an elevated level of glutamic acid in the brain tissue was found during the second and third days following irradiation. A similar picture was found for gamma aminobutyric acid. Namely, on the first day after irradiation, the level of the amino acid was not altered. However, on the second, and particularly on the third day, values for the amino acid were higher than in normal controls. No correlation with absorbed dose was obtained. (P.C.H.)

8922 THE EFFECTS OF VISIBLE AND ULTRAVIOLET LIGHT ON THE REGENERATIVE GROWTH OF PLANARIAN. Johann Haslauer. Strahlentherapie, 125: 604-30(Dec. 1964). (In German)

The LD_{50}' for the uninjured planaria was found to be 390 R.D.E. and for the regenerating (decapitated) planaria 420 R.D.E. Even in the case of lethal doses (for the wavelengths used) regeneration could not be inhibited. Fractionated irradiation resulted in a decrease in the biological effect (time factor smaller than 1). In the region of a reactive radiation burden, the equilibrium between primary radiation damage and secondary recovery events depended upon temperature (intensity of metabolism), upon the degree of the radiation burden, and upon the time interval between the single doses. Small radiation exposure (small doses distributed over the total course of regeneration) caused a significant stimulation of the regeneration growth. The same radiation damage was produced with medium to short uv light as was produced using the total spectrum (dose equivalence = 1). In the case of Dendrocoelum lacteum a different damage course was observed than with Euplanaria gonocephala. The trunk was more radiosensitive than the newly formed regeneration cone because of its lack of pigment. For the plastic state of the regeneration (cutting the planaria into segments) a considerable increase in radiation resistance was found. (P.C.H.)

8923 CHANGES OF THE NUCLEIC ACID CONTENT IN RABBIT ORGANS UNDER THE IRRADIATION OF ROENTGEN RAY. Norichika Miyawaki (Tohoku Univ., Sendai). Tohoku J. Exptl. Med., 82: 373-86(May 25, 1964).

The effect of x irradiation and of intravenous injections of the so-called radiopathogenic substance (Radiotoxin A) on the content and the base composition of the nucleic acid in the liver, spleen, adrenal glands, and bone marrow of rabbits was studied. Radiotoxin A was extracted from blood cells of rabbits which showed symptoms of radiation sickness, such as leucopenia, after x irradiation to the hypogastric region. A dose of 500 R was given once a day for eight days successively (total 4000 R). The experimental animals were given intravenously a single injection of 15 mg of Radiotoxin A per kg of body weight and successive injections of 10 mg per kg for five days. In control rabbits which developed symptoms of radiation disease, the content of RNA in the liver and adrenal glands and DNA in the spleen and bone marrow showed a marked decrease. Similar findings were obtained in the unirradiated rabbits after Radiotoxin A; especially in the group after serial injections of Radiotoxin A, changes of RNA or DNA in the organs were more marked than in the irradiated groups. The base composition of the nucleic acid was changed by irradiation or intravenous injection of Radiotoxin A. Thus adenine of RNA in the liver decreased markedly, and adenine of DNA in the spleen and bone marrow also decreased. Cytosine and uracil of RNA in the liver and cytosine and thymine of DNA in the spleen decreased, whereas cytosine of DNA in the bone marrow increased. Serial injections of Radiotoxin A induced the most marked changes. The clinical application of these results to patients subjected to radiation treatment is discussed. It is suggested that it may be of considerable practical significance in the therapy of side-effects of the radiotherapy to use adenine derivatives, and perhaps also cytosine and pyrimidine derivatives. (BBB)

8924 THE DIRECT RESPONSE OF THE CARDIOVASCULAR SYSTEM OF ANIMALS TO THE EXTERNAL EFFECT OF IONIZING RADIATION. K. Sh. Nadareyshvili. Tr. Inst. Fiziol., Akad. Nauk Gruz. SSR, 13: 219-36(1963).

The blood pressure (common carotid artery, circle of Willis and external jugular vein), respiration and EKG were measured in unanesthetized rabbits subjected to x irradiation in acute experiments. General or local irradiation of various areas of the rabbit body produced direct responses in the cardiovascular system and respiration. The character of these responses was determined by the localization of the effect and the dosage. The response of the vascular system was expressed in dilatation of the vessels, although the cerebral vessels underwent contraction. The integral response of the general arterial blood pressure was depressive or biphasic. The threshold dose for the appearance of the vascular response varied greatly. With an increase in the number of exposures, the threshold increased sharply until disappearance of the response even at maximal dosage. After adaptation to small doses, a further rapid increase gave a repeated but weakly pronounced direct response. The latent response period for suprathreshold radiation doses fluctuated from 0.2 to 0.8 seconds. The length of irradiation necessary for the appearance of a direct response was no more than 8-10 seconds. A response could be observed repeatedly if the interval between exposures was not less than 3-5 minutes. With a decrease in the interval, the response weakened or disappeared completely. After a 1-hr test the response appeared again, but only if the total dose of whole-body irradiation did not exceed 150-200R. With local irradiation, the response disappeared when the total dose reached 2000–2500R. It is suggested that the direct responses are an integral expression of reflex and humoral shifts in answer to changes in all the links of the vital processes, resulting from ionization and formation of biologically active substances that cause partial depolarization of the synaptic formations and disruption of the internal equilibrium of metabolic and functional activity. The organism responds to these changes by mobilization of the nervous and humoral mechanisms directed toward the maintenance of the stability of the internal milieu and the establishment of a new level of interrelationships in the hemostatic apparatus. (OTS)

8925 EFFECT OF X-RAYS ON REGENERATION OF SKELETAL MUSCLE AFTER SINGLE OR REPEATED IRRADIATION. T. N. Tuzhilkova. Tr. Kafedry Normal'n. Anatomii Cheloveka Chelyab. Med. Inst., No. 2, 194-8(1963).

Sixty adult rats were divided into three groups. In the first group, regeneration of the shin muscle was studied following transverse section at a depth of 3 mm (controls). In the second group, the same operation was carried out 24 hours after the last of a series of daily irradiations of the limbs of 100 R each for 1 month (total dose 3000 R). In the third group, transverse section of the muscle was carried out 24 hours after a single irradiation of the extremity with a dose of 3000 R. The irradiated and non-irradiated extremities were examined at 5, 10, 20, and 30 days after the operation. Repeated or single irradiation of the shin with a dose of 3000 R inhibited regeneration of the traumatized muscle. Thus, in the extremities of non-irradiated controls, the degenerative, inflammatory, and proliferative processes were completed by the sixth day, whereas in extremities receiving a single x-ray dose, degenerative processes were prolonged, and resorption of decay products was slow. After a single x-ray dose healing was observed 10–20 days after damage, and consisted of splitting of muscle fibers and enlargement of their nuclei without subsequent formation of muscular buds. There was no regeneration of muscle fibers. A similar healing pattern was observed in extremities irradiated with repeated fractionated doses, although here the inflamatory reaction was less intense. On the 30th day, the site of the defect in irradiated extremities was filled with a connective tissue scar, but not with muscular tissue. It is suggested that x irradiation suppresses muscle regeneration whether in single or in repeated fractionated doses. (OTS)

8926 TRANSPLANTATION OF SKIN AFTER EXCISION OF A DEEP BURN WOUND AGAINST THE BACKGROUND OF ACUTE EXPERIMENTAL RADIATION INJURY. V. V. Veselov and A. I. Il'ina. Tr., Nauchn.-Issled. Inst. Sintetich. Zhirozamenitelei i Moyushchikh Sredstv. 2: 19-25 (1961).

Experiments were performed on 45 rabbits. The animals of one group were given third degree thermal burns; those in a second group were irradiated once with a dose of 900–1050 R and then subjected to thermal burns. On the 3rd day, the burn wounds were treated and then covered with an auto or homotransplant of skin. Homotransplants survived only 3–5 days, after which they became suppurative and separated; healing was by secondary intention. Complex surgical and general supportive treatment of the burns decreased the number of deaths. It was concluded that the only effective method of treatment is autotransplantation. (OTS)

8927 MINERAL COMPOSITION OF BLOOD SERUM (K, Ca, P) IN EXPERIMENTAL ACUTE RADIATION SICKNESS. F. G. Mukhtarova. Tr. Uzbeksk. Nauchn.-Issled. Inst. Gematol. i Pereliv. Krovi, 2: 238-40(1962). (In Russian)

Results are reported from measurements of the effects of a single whole-body exposure to doses of 1200, 1400, and 2000 R x radiation on the content of Ca, K, and P in the blood of rabbits. An increase in K and a decrease in Ca and P were noted. (C.H.)

8928 REJECTION OF ALLOGENEIC SKIN GRAFTS BY SUBLETHALLY IRRADIATED AND NONIRRADIATED MICE SENSITIZED WITH SPLEEN CELLS AND FREUND'S ADJUVANT. Marvin L. Tyan (Karolinska Inst., Stockholm and Naval Radiological Defense Lab., San Francisco). Transplantation, 3: 54-61(Jan. 1965).

Allogeneic dissociated spleen cells incorporated in Freund's complete adjuvant and injected s.c. induced a homograft response as radioresistant as that produced by a skin graft. In two of three strains of mice studied, allogeneic dissociated spleen cells alone, when injected s.c., induced a homograft sensitivity only slightly less radioresistant than that induced by skin grafts. Anatomical separation of the injection sites of allogeneic dissociated cells and Freund's complete adjuvant produced a homograft response more radiosensitive than that induced by spleen cells alone. (auth)

8929 ON CHANGES IN QUANTITATIVE RNA CONTENT IN PURKINJE'S CELLS OF THE CEREBELLUM AFTER X-RAY TREATMENT. V. I. Sharobaiko (Univ. of Leningrad). Tsitologiya, 6: 101-4(1964). (In Russian)

The effect of exposure to a whole-body 400 R dose of x radiation on the content of ribonucleic acid (RNA) in Purkinje cells of rat cerebellum was measured. The content of RNA was observed to decrease during the first 2 to 6 hr after irradiation and return to normal within 12 hr. (C.H.)

8930 HISTOCHEMICAL INVESTIGATION OF POLYSACCHARIDES IN TESTES OF RATS AFTER IRRADIATION. A. K. Mirakhmedov. Uzbeksk. Biol. Zh., 7: No. 6, 77-9 (1963). (In Russian)

Rats were sacrificed periodically from one to 90 days after exposure to 400 R γ radiation at a dose rate of 26 to 33 R/sec. and after exposure for one hr. to mixed neutrons and γ radiation from a reactor, with an estimated dose of neutrons of 33.3 rads and 72 R γ radiation. No differences were noted between the effects of γ and neutron irradiation on the content of polysaccharides in the testis of the irradiated rats. Both neutron and γ radiation caused changes in the content of polysaccharides in spermatids and in other cell elements of the irradiated germinal cells. (C.H.)

8931 THE EFFECT OF γ-RADIATION ON THE DIACETYL PRODUCTION OF STREPTOCOCCUS DIACETILACTIS 13/C65 CULTURES. [PART] I. A. G. Grinevich and D. Ogai. Uzbeksk. Biol. Zh., 8: 7-12[1964]. (In Russian)

An increased production of diacetyl in Streptococcus diacetilactis was observed with increasing doses of gamma radiation. Diacetyl was detected by a red culture after the addition of 8 ml of 20% NaOAc, 5 ml of 20% $NH_2OH.HCl$, and 5 ml of 10% $NiCl_2$ to 100 ml of culture liquid. The formation of a yellowish-red color was measured colorimetrically with a green filter. (P.C.H.)

8932 THE COURSE OF EXPERIMENTAL MYOCARDITIS INFARCT DURING ACUTE RADIATION SICKNESS. N. B. Ginzburg. Voenno-Med. Zh., No. 12, 21-4(Dec. 1962). (In Russian)

Experiments were carried out on 34 adult rabbits and 11 dogs (16 rabbits and 5 dogs served as controls). In one experimental group the coronary artery was tied off at the beginning of the peak of the radiation sickness; the other experimental group was irradiated at the beginning of the subacute period of the myocardial infarct. Electrocardiograms of the first group showed changes characteristic of acute interference with the blood supply of the anterior wall of the left ventricle. The disturbance lasted much longer in group 2. Pneumographic changes occurred in both groups, but were more pronounced in group 1. Morphological changes are described. (IIC-M.G.)

8933 ENERGY METABOLISM OF IRRADIATED RATS. Blahoslav Zicha (Veterinarni Vyzkumne Stredisko, Prague). Vojenske Zdravot. Listy, 31: 22-5(1962). (In Russian)

The effects of a whole-body dose of 800 R x radiation on the metabolism of adenosinephosphoric acids in rats were studied. The content of adenosine triphosphate (ATP) in blood decreased rapidly during the first 24 hr after irradiation and more slowly during the next 12 days; changes in the content of adenosine diphosphate (ADP) and adenosine monophosphate (AMP) in blood were not remarkable; the content of ATP in muscle decreased rapidly during the first 24 hr after irradiation but returned almost to normal by the 12th day; the content of ADP in muscles increased significantly over the 12 day period; the content of AMP in muscles decreased to almost zero during the first 24 hr and remained permanently decreased; the content of ATP and AMP in liver decreased rapidly during the first 24 hr but gradually increased to nearly 50% of normal during the 12 day period. (C.H.)

8934 EFFECT OF γ-IRRADIATION ON CATALASE ACTIVITY AND CONTENT OF ORGANIC PEROXIDES IN COTTON. S. Khalikov. Vopr. Biol. i Kraevoi Med., Acad Nauk Uz. SSR, Otd. Biol. Nauk, No. 4, 45-9(1963). (In Russian)

Seedlings of two varieties of cotton were exposed to doses of 0.2 to 10 kR x radiation 2 to 3 days after sprouting. Results are reported from measurements of catalase activity and content of organic peroxides in roots, shoots, and cotyledonous leaves. (C.H.)

8935 THE EFFECT OF EXOGENOUS CYTOCHROME C ON OXYDATIVE PHOSPHORYLATION IN MITOCHONDRIA ISOLATED FROM TISSUES OF IRRADIATED ANIMALS. S. E. Manoylov and K. P. Khanson. Vopr. Med. Khim., 10: 410-13(1964).

Experiments were performed for the purpose of comparing the effect of exogenous cytochrome C on oxidative phosphorylation in mitochondria washed out from cytochrome C and in mitochondria isolated from tissues of irradiated animals in order to get additional information on the mechanism of the cytochrome effect. Mitochondria washed out by means of a hypotonic solution of potassium chloride lose their ability to perform coupled oxidative phosphorylation. Two hours after whole-body irradiation of rats by doses of 800 R, mitochondria of the spleen lose their ability to perform oxidative phosphorylation. In both cases, the addition of exogenous cytochrome C restored this function. (ATD Press)

8936 CHANGES OF THE CONTENT OF BLOOD SERUM PROTEIN FRACTIONS IN ACUTE RADIATION SICKNESS. L. N. Kuzmenko, M. D. Podilchak, D. A. Makar, E. A. Yurmin, V. M. Pobegailo, and V. S. Chepovskii. Vrachebnoe Delo, No. 2, 85-8(1964). (In Russian)

Acute radiation sickness is accompanied by characteristic quantitative and qualitative changes of the peripheric blood. A decrease of total protein did not vary significantly in acute radiation sickness. Characteristic changes of alpha-1 and alpha-2 globulin fractions were found; the beta-globulin fraction increased only slightly, and the gamma-globulin fractions decreased in the acute stage of radiation sickness. (auth)

8937 SERUM PROTEIN CHANGES IN RHESUS MONKEYS DURING IMMUNIZATION AND FOLLOWING CHALLENGE BY SCHISTOSOMA JAPONICUM. S. Y. Li Hsu and H. F. Hsu (Iowa State Univ., Iowa City). Z. Tropenmed. Parasitol., 15: 43-56(Apr. 1964).

Monkeys were inoculated four times with cercariae of the Formosan strain of Schistosoma japonicum and other monkeys were inoculated four times with x-irradiated (2000 to 3000 R) cercariae of the Japanese strain. No notable changes were observed in the serums during the period of immunization as determined by the biuret method for total proteins and the paper electrophoretic method for albumin, and globulins. Nonimmunized monkeys and others with various degrees of immunization were challenged with 200 male and 200 female non-irradiated cercariae of the Japanese strain. The average number of eggs per gram of stool in the first 30 days of the period was used as a criterion to measure the intensity of infection in each monkey. Total proteins and the fractions of proteins in serum were determined for each monkey immediately before challenge and at 29 to 63 days after challenge. High correlations were found between the intensity of infection (measured by the number of eggs in the stools) and the total proteins and between the intensity of infection and percentage values of albumin and globulins. In monkeys with very low intensity infection, no notable changes in any fractions of serum proteins were observed; in those with moderate intensity of infection, significant changes were found in albumin and γ-globulin; in those with high intensity of infection, additional change was noted in α_2-globulin; and in those with still higher intensity of infection, there were significant changes in the total proteins and in all the five globulin fractions. While the per cent of albumin decreased with the increase of the intensity of infection, the per cent of all four globulins increased with the increase of the intensity of infection. The total proteins in the serum, on the other hand, showed slight increase in the monkeys with low intensity of infection but manifested a sharp decrease in the monkeys with very high intensity of infection. The possibility of using cercariae of the F strain or x-irradiated cercariae of the J strain to vaccinate rhesus monkeys and man against infection by Schistosoma japonicum are discussed. (BBB)

8938 UROLOGICAL COMPLICATIONS FOLLOWING IRRADIATION. W. Schmidt (Medical Academy, Magdeburg, Ger.). Z. Urol., 57: 287-91(1964).

A review is given of the changes in the changes in the kidney, ureters, bladder, and urethra after irradiation of the abdominal cavity. Their genesis, treatment, and significance for the chances of recovery in carcinoma of the female genital organs are discussed. (Excerpta Med., Sect. 23, 1: (Nov. 1964))

8939 FORMATION OF GIANT NUCLEI IN CONTINUOUSLY IRRADIATED TUMORS. Austin M. Brues and Agnes N. Stroud (Argonne National Lab., Ill.). Z. Zellforsch., 64: 52-62(1964).

Transplantable malignant tumors of mice and rats were irradiated continuously for several days by means of embedded glass beads containing ^{90}Sr−^{90}Y. Concomitant enlargement of tumor cell nuclei occurs in areas where mitosis is inhibited, i.e. associated with doses of 1200−2000 Rads per day and above. Some enlarged cells survive at least a week in areas where the dose rate is much higher than this. Intense incorporation of thymidine into enlarged cells can be seen at least a week after beginning irradiation. (auth)

8940 PATHOGENESIS OF MALIGNANT TUMORS FOLLOWING THOROTRAST. P. Freese and P. Kemnitz (Medical Academy, Magdeburg, Ger.). Zentr. Allgem. Pathol. Pathol. Anat., 105: 161-9(1964).

A report is given on three cases of malignant tumors provoked by thorotrast that developed after a latency period of 23 to 29 yrs. In these cases Hieronymi's conditions for recognition of a causal relationship between the thorotrast deposits and the carcinogenesis were met to a large extent. (Excerpta, Med., Sect. 23, 1: (Nov. 1964))

8941 MORPHOLOGICAL AND REPRODUCTIVE VARIATION UNDER FOUR ENVIRONMENTAL PRESSURES IN AN INBRED STRAIN OF DROSOPHILA MELANOGASTER. Thomas Vincent Come. Thesis, University Park, Penna., Pennsylvania State Univ., 1963. 65p.

The primary objective of this study was to determine the effect of radiation-induced mutations on the level of homozygosity in an inbred line of Drosophila melanogaster, as determined by variance in phenotypic responses. The study contained three major aspects: selection for thorax length, genotype-temperature interactions, and small population density effects. Six lines of flies were developed from a temperature adapted line of Drosophila melanogaster (A3V) inbred for over 150 generations. High, low, and control lines, with and without irradiation, for thorax length were maintained for six generations of selection. All lines were subjected to three temperature variations during the seventh generation. Data were obtained on thorax length, viability and sex ratios during all generations studied. The study indicates that genetic variability for thorax length is present in this highly inbred stock. The factors concerned with size are, at least in part, epistatic to viability. The results show that at least four environmental factors can act as determiners of adult thorax length, and that interaction is present between some of these determiners: radiation can cause a reduction in body size and in viability; (2) larval density will also affect body size, with or without irradiation; (3) selection pressure reduces fecundity; this reduction is greater in the low selected lines; (4) temperature variation affects both body size and fecundity in Drosophila melanogaster. (Dissertation Abstr., 25: No. 2 (Aug. 1964))

8942 OVA TRANSFERS IN SHEEP AND RABBITS; STUDIES ON MATERNAL INFLUENCES AND IRRADIATION DAMAGE. William Lynn Hunt. Thesis, Corvallis, Ore., Oregon State Univ., 1964. 99p.

The first study utilized ova transfer in sheep and involved hormonal treatments for synchronization of estrus and superovulation in an investigation of crossbred maternal influences on inbred and linecross lambs. Synchronization of estrus in ewes was achieved effectively with either oral progestogen, 6α-methyl-17α-hydroxy-progesterone acetate, or intramuscular injections of progesterone. After progesterone injections, superovulation was obtained using pituitary extracts. Twelve Suffolk ewes of three inbred lines were bred to produce fertilized ova from each of three lines and from each possible linecross. Surgical transfers of ova from Suffolk donors were made to nine recipients. The inbred line II lamb, which developed in a crossbred maternal environment, weighed 12.3 percent more at birth than its non-transfer line II counterpart. The transferred linecross III × II lamb weighed 30.6 percent more at birth than its non-transfer counterpart. Adjusted 120-day weights, condition, and conformation scores were similar for transfer and non-transfer lambs at weaning. In the second study effects of in vitro x irradiation of fertilized mammalian ova on their subsequent in vivo development were investigated by means of rabbit ova transfer. Non-irradiated and irradiated two-cell ova were transferred to non-irradiated and irradiated uteri of recipients to discriminate between embryonic and uterine injury. Combination of ova/uterus irradiation showed additive effects of x-ray damage. One step increases of either ova or uterus above 61.2/250.3 Rads caused 100 percent embryo mortality. Two-cell ova given 122.5 Rads of irradiation failed to develop into fetuses, and uteri given 530.5 Rads failed to contain implantations. Irradiation with 61.2 Rads caused abnormal, dead, and resorbed fetuses as well as living offspring. Two such newborn developed latent sequelae in the form of spreading limbs. Mean increase in weight for the first 50 days of surviving offspring from irradiated ova was 6 g/day more than that of controls. (Dissertation Abstr., 25: No. 2 (Aug. 1964))

8943 ANALYSIS OF POSTIRRADIATION MODIFICATION OF GENETIC DAMAGE IN MATURE DROSOPHILA MELANOGASTER SPERM. James Edward Trosko. Thesis, East Lansing, Mich., Michigan State Univ., 1963. 60p.

The recovery phenomenon reported to be associated with post-irradiation modification of the genetic damage in mature Drosophila spermatozoa was studied. Sex-linked lethal mutation rate, egg-hatch, and counts of total progeny were used to measure the damage in irradiated mature Drosophila spermatozoa. Comparisons of these measured criteria were made between sperm, either non-aged or aged under experimental conditions. The results indicate that neither aging for two weeks nor a temperature of 10°C changed the sex-linked mutation rate when the irradiated sperm were stored in the females. Pre-aging the females on minimal medium at room temperature prior to mating increased the frequency of detected sex-linked lethals. Although lower rates of biological damages were observed in the second sperm batch than in the first sperm batch of all irradiated males, the difference between the two sperm batches was smaller for the males stored at room temperature than non-stored or cold-stored males. The damage associated with the first sperm batch of cold-stored irradiated males was not different from that of the first sperm batch of non-stored irradiated males. These latter two observations were interpreted to indicate that mixing of sperm, rather than recovery, occurred in males stored at room temperature prior to mating. The cold temperature storage did not significantly modify the measured damage. It was observed after comparing the results of the sex-linked and dominant lethal studies that the cold temperature post-treatment of the irradiated males may have increased the recovery of sex-linked lethals while decreasing the frequency of dominant lethals. (Dissertation Abstr., 25: No. 2 (Aug. 1964))

8944 EFFECTS OF GAMMA IRRADIATION OF CERCARIAE ON THE HOST-PARASITE RELATIONSHIPS OF SCHISTOSOMA MANSONI. Duane Gordon Erickson, Thesis, Minneapolis, Univ. of Minnesota, 1964. 167p.

The effects of gamma radiation on schistosome host-parasite relationships were evaluated by observing (1) the effects of irradiating cercariae with various dosages on the development of schistosomes in mice, (2) the production of resistance in rats and mice exposed to irradiated cercariae, (3) the fate of irradiated schistosomes in mice, and (4) the anemia induced in mice by irradiated-schistosome infections as compared with that induced by normal unisexual or bisexual infections. Cercariae were exposed to gamma radiation from a ^{60}Co therapy unit. Both perfusion and histological techniques were used in studying the fate of irradiated schistosomes. Hematocrit and hemoglobin determinations were used to evaluate the degree of anemia produced. The results support the following conclusions. Exposure to irradiated schistosomes induces resistance in animals to subsequent cercarial exposures. Schistosomes irradiated with 8000 R die in the mouse between 22 and 50 days and the majority of them perish while in the liver. Egg deposition is the chief cause of the pathological changes which produce severe anemia in schistosomiasis in mice, and the mere presence of male and female schistosomes together in mice is no more pathogenic, as far as production of anemia is concerned, than is a numerically equivalent unisexual schistosome infection. (A.G.W.)

8945 THE ANTIOXIDANT AND PRO-OXIDANT ACTIVITY IN ASCITES TUMORS. Edward David Lash. Thesis, Chicago, Univ. of Illinois, 1964. 75p.

Examination of Ehrlich and Krebs-2 ascites tumor cells with respect to their antioxidant content and their ability to form lipid peroxides suggested the presence of protective antioxidants in these cells. Aerated liver homogenate was used as a peroxide-forming test system. Intact tumor cells did not inhibit lipid peroxidation when aerated with liver homogenate. Lysed cells of both tumors were inhibitory. Antioxidant activity was present in both the cytoplasmic and nuclear fractions of the tumors. A pro-oxidant component was also demonstrated in the cytoplasmic fraction. The activity in the nuclear fraction was destroyed within 5–10 min in a boiling water bath. The same was true of the cytoplasmic pro-oxidant. The cytoplasmic antioxidant was stable to heating for up to 20 min. Both the nuclear and cytoplasmic antioxidants were precipitated with cold acetone. In addition, the activity in heated cytoplasm was located in the heat precipitated material. Large doses of ultraviolet irradiation caused a decrease in the antioxidant activity in both the Ehrlich and Krebs-2 cells. In vitro x irradiation (90 kr) had little effect on cytoplasmic pro- and antioxidant levels, but caused a slight decrease in the nuclear activity. Tumor-bearing mice exposed to 1250 R of x rays were sacrificed at 14 and 24 hours post-irradiation, and the tumor fractions were assayed. No changes were found in either the nuclear or cytoplasmic antioxidant activity. The mean generation time of ascites tumors may increase some 3–4 fold as the tumor ages. Both 7-day and 10-day tumors were assayed and no differences in antioxidant levels were observed. The characteristics of the antioxidants in ascites tumors differ in several respects from those in other tissues examined. (A.G.W.)

8946 SLUCHAI OSTROI LUCHEVOI BOLEZNI U CHELOVEKA. (A Case of an Acute Radiation Sickness). N. A. Kurshakov. Moscow, State Publishing House of Medical Literature, 1962. 152p.

Clinical description is given of acute radiosickness observed in a 19-year-old boy who intentionally induced the sickness by carrying on his body a ^{137}Cs ampule (10 g-equivalent-Ra activity) for 20 hours. (R.V.J.)

8947 MODIFICATION OF RADIOBIOLOGICAL OXYGEN EFFECTS IN VERY DRY BARLEY SEEDS. John Rodney Harle. Thesis, Pullman, Wash., Washington State Univ., 1963. 68p.

In the present research on the oxygen effect, new techniques were evolved, including irradiation of much drier seeds in evacuated glass vials. Greater control of oxygen availability and maintenance of low seed moisture contents contributed to oxygen effect factors ranging up to 10. Improved techniques made possible the employment of a variety of post-radiation treatment conditions in studies of the influence of water, temperature, and radiation energy upon the magnitude of the oxygen effect. The action of the four modifying factors is interpreted on the basis of results obtained here and in terms of conclusions drawn from electron spin resonance studies of the characteristics of free radicals in irradiated seed embryos. All four modifying factors are interdependent, but each partially determines the ultimate fate of products of irradiation. The magnitude of the oxygen effect is controlled by availability of oxygen at critical sites, moisture content of the seed during and after irradiation, and the rate of influx of water during rehydration, determining radical recombination rates, temperature during and after irradiation, governing the reaction rate of free radicals with other molecules in irradiated cells, and also rates of radical recombination, and the type and energy of radiation, or linear energy transfer, affecting the spatial distribution of free radicals, which governs their longevity. (A.G.W.)

8948 FACTORS AFFECTING RECOMBINATION IN BARLEY. Jerrel Buel Powell. Thesis, Pullman, Wash., Washington State Univ., 1963. 133p.

Experiments were conducted to determine (1) effects of ionizing radiation, low-calcium nutrition, and temperature on recombination of four genetic traits, (2) the effects of temperature on crossing-over as measured by frequency of bridges and fragments in microsporocytes in an inversion heterozygote, (3) the amount of crossing-over in a heterozygote containing two inversions, and (4) the occurrence of chromosome rearrangements and especially bridge and fragments in microsporocytes of varietal hybrids. In the genetic recombination experiments both x rays and temperature were effective in inducing recombination changes; low-calcium nutrition was not. Temperature was markedly effective in modifying crossing-over in the Holm inversion as measured by frequencies of microsporocytes with bridges and fragments. Highest crossover rates were obtained at 60°F; the lowest crossover rates occurred at 34° to 55°F. A slight decrease in rate of crossing-over occurred at 70°F. The combined effects of two different inversions produced high frequencies of double crossovers. Plants containing both heterozygous inversions exhibited four times the number of double crossovers as found in plants containing single inversions. Certain varietal hybrids, particularly the hybrids involving OAC 21, exhibited low frequencies of bridges and fragments in microsporocytes. The uniformity of fragment size associated with the Anaphase 1 bridges in the different hybrids suggested that an inversion was present in one of the parent varieties of the crosses. (Dissertation Abstr., 25: No. 3, Sept. 1964)

8949 LIPID COMPOSITION OF THE TESTES OF WHITE RATS AND GUINEA PIGS UNDER NORMAL CONDITIONS AND IN A STATE OF POST-IRRADIATION ATROPHY. E. A. Pokrovskii. p.49-57 of "Novye Dannye po Biokhimii Polovykh Zhelez v Norme i Pri Nekotorykh Patologiya Sostoyaniyakh (Luchevye Povrezhdeniya i Gipoksiya)." Kalinin, USSR, Knigoizdat, 1963.

The area of the right testis of rats was subjected to local x irradiation with a single dose of 660 R with shielding of the left testis and of the remainder of the body. A second group of rats received chronic daily (except weekends) whole-body x irradiation at a dose of 10 R for 1 min for 4 months. The lower part of the abdomen of adult male guinea pigs was subjected to x irradiation at a dose of 258 R for 10 min. Two months after acute irradiation, and after the last dose of chronic irradiation, determinations were made of the lipid composition of the testes. Histological examination revealed radio-induced atrophy of the testes in both rats and guinea pigs. The testicular weight was significantly lower, and the water content higher than in the controls. The phospholipid content (including plasmogens) of the irradiated rat testes was considerably lower than in controls, while the content of neutral fats and of other unidentifiable lipids was higher; the total content of structural lipids was higher. In the guinea pig testes, the neutral fat content was only about half that in controls (but 4 times as high as in rats); in these animals, the total absolute content of structural lipids was unchanged, while the relative content was increased (due to a sharp decrease in neutral fats). Chromatographic studies showed that the principal components of the testicular phosphatides were phosphatidylethanolamine, phosphatidylcholine, phosphatidylserine, sphingomyelin, and phosphatidylinositol. There were no qualitative differences in the testicular phosphatide composition of control and experimental animals. (OTS)

8950 LUCHEVYE PORAZHENIYA I VOSSTANOVITEL'NYE PROTSESSY V TSENTRAL'NOI NERVNOI SISTEME MLEKOPITAYUSHCHIKH V ONTOGENEZE. (Radiation Injuries and Repair Processes of the Central Nervous System in Mammalian Ontogenesis). A. A. Manina. [Leningrad], Meditsina, 1964. 228p.

Studies are presented on the effects of various types of ionizing radiation on the central nervous system of mammals (rats, rabbits, guinea pigs, and others) in various stages of embryonic and postnatal development. Radiosensitivity of the nervous system was tested in various animals and dynamics of the repair processes, especially regeneration of the central nervous system, were considered. Evidence of tissue malformation, the mechanism of their development, and the regenerative ability of the injured central nervous system are discussed. The studies were carried out using various histological, histochemical, and neurohistological methods. Extensive references are included. (R.V.J.)

8951 IN VIVO AND AIR DOSIMETRY OF FISSION SPECTRUM NEUTRONS. Vincent T. Penikas and Thomas S. Mobley (Univ. of Rochester, N. Y.). 8p. (CONF-217-3).

From Radiation Research Society 11th Annual Meeting, Milwaukee, May 1963.

A bare cylindrical, enriched-uranium metallic reactor assembly was used for the studies. The reactor was pulse operated producing a 50 microsecond pulse width at half maximum pulse height and a fuel material temperature rise of about 100°C. Sheep, dogs, and miniature swine were exposed to a mixed neutron-gamma radiation field from the reactor. The air dose, entrance and exit doses were measured. Dosimetry packages were surgically implanted to obtain an estimate of the tissue depth dose in the living animal. The neutron dose was determined by means of threshold foil measurements. Gold and cadmium covered gold were used for determining the integrated thermal flux; plutonium-239, neptunium-237, uranium-238, and sulfur-32 for determining the integrated fast neutron fluxes; and metaphosphate glass rods containing silver for determining the gamma dose. All animals received lateral exposures at a midline distance of two meters from the reactor core center. The neutron Rad dose measured in air was 159 ± 6.5 for a burst temperature rise of 100°C. The gamma dose was 32 ± 2.7 R. The entrance and exit doses as well as the dose to the internal package varied among the three species and depended upon the burst temperature rise, distance from the reactor, orientation of the foils with respect to the reactor, and the thickness and composition of the attenuating tissues. (auth)

Radiation Effects Therapy and Countermeasures

8952 (AD-601838) SYNTHESIS OF STEREOSPECIFIC AMINOTHIOLS AS RADIOPROTECTIVE AGENTS. Interim Progress Report, March 1, 1963–March 1, 1964. J. Cymerman Craig (California. Univ., San Francisco. Medical Center). Contract DA-49-193-MD-2145. 9p. $0.50(OTS).

Trans-2-(n-octylamino)cyclopentanethiol and trans-2-(n-decylamino)cyclopentanethiol were synthesized and submitted for testing as radioprotective agents. The preparation of cis- and trans-1-aminoindane-2-thiol is in progress. Successful reduction methods were developed for the preparation of 2-methyl-4, 5-cyclopentano-thiazolidine and spiro-2, 2-cyclohexano-4, 5-cyclopentanothiazolidine. The conversion of these two key compounds into the required cis-2-aminocyclopentanethiol is under examination. (auth)

8953 (NP-14448(p.36-64)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. I. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE. V. J. Plzak, M. Root, and J. Doull (Chicago. Univ. Air Force Radiation).

Thirty-six compounds were evaluated for their radioprotective effects in mice. The compounds tested were related to compounds previously found to possess radioprotective activity and 31 were found to exhibit varying degrees of protection, with 8 of them allowing 60% or more of the mice to survive on otherwise lethal dose of whole-body x radiation for at least 30 days after the exposure. Those affording the best protection included compounds of quinoxaline, dimethylsulfoxide, quinolinol, 3-hydrazinoquinoline dihydrochloride, monothioglutarimide, and N-phenylmonothiosuccinimide. The chemical formula and pharmacological data on each compound tested are included. (C.H.)

8954 (NP-14448(p.65-97)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. II. DOSE-MORTALITY RELATIONSHIPS FOR SEVERAL RADIOPROTECTIVE AGENTS. J. Doull and V. Plzak (Chicago. Univ. Air Force Radiation Lab.).

Studies were carried out to determine the dose reduction factors (DRF) for sixteen chemical agents in CF_1 male mice exposed to whole-body x irradiation at dosage levels of 400 R through 1,200 R. The DRF calculations were based on the 30-day mortality data in groups of pretreated animals using a maximum likelihood estimate analysis method programmed for computer analysis. The results of these studies indicated that a serotonin derivative (WL-6) and methacrylonitrile (ST-40) were the most effective of the agents tested (DRF of about 1.4). Cis-1,2-diisopropyl-cyclobutane dicarboxylate (ST-34) and 4-(methylthio)-m-cresol (MA-17) were also effective radioprotective agents (DRF of about 1.3) and cyclobutane-1,2-bis(methylammonium) distearate (ST-9), dimethylsulfoxide (DMSO,CZ-2), monothiosuccinimide (WI-1), WL-17 and GE-16 were of about equal effectiveness (DRF of about 1.2). PD-43, GE-17, and SC-19 exhibited DRF values of about 1.1 and the remaining agents did not appear to be radioprotective under the conditions of these studies. (auth)

8955 (NP-14448(p.108-15)) PHARMACOLOGICAL AND TOXICOLOGICAL COMPOUNDS AS PROTECTIVE OR THERAPEUTIC AGENTS AGAINST RADIATION INJURY IN EXPERIMENTAL ANIMALS. IV. FURTHER STUDIES ON THE RADIOPROTECTIVE ACTION OF SODIUM NITRITE IN MICE. A. T. Hasegawa and H. D. Landahl (Chicago. Univ. Air Force Radiation Lab.).

Results are reported from studies of factors involved in the protective action of sodium nitrite against radiation injuries in mice. The methemoglobin level measured 24 minutes after nitrite injection was 80% in mice subjected to 4 atmospheres of oxygen and 81% in those kept in room air. The corresponding nitrite levels were 314 and 414 μg/ml. Under 1 atmosphere of oxygen the average oxygen tension in the spleen following nitrite injection was close to normal when measured at 21 minutes while the oxygen tension in the vena cava decreased to 48% of normal. Under 4 atmospheres of oxygen both spleen and vena cava oxygen tension in nitrite-treated mice were maintained above normal. The dose reduction factor of 1.66 was obtained when nitrite-treated mice were irradiated at 1 atmosphere of oxygen and a factor of only 1.15 was obtained when the mice were irradiated at 4 atmospheres of oxygen. Irradiation of normal mice showed that there were no significant differences in the LD_{50} values between those irradiated in air or in oxygen at 1 or 4 atmospheres, and whether irradiated at 220 or 600 R/minute. It was found that the dose reduction factors in all the situations could be calculated in a simple way from a knowledge of tissue oxygen and the nitrite dose. (auth)

8956 (JPRS-27220) FURTHER EXPERIMENTS ON CHEMOTHERAPY IN THE TREATMENT OF RADIATION SICKNESS. M. A. Tumanyan and A. V. Izvekova. Translated from Antibiotiki, 9: 719-22(Aug. 1964). 6p. (TT-64-51475). $1.00(OTS).

The antibiotics phenoxypenicillin, mycerin, monomycin, and sulfamide phthalazine gave good results in the treatment of rats and rabbits for infectious complications of radiation sickness. (C.H.)

8957 A BIOLOGICAL ASPECT OF THE PROTECTIVE ACTION OF AET AGAINST X-RAY IRRADIATION IN MICE. Tsutomu Sugahara, Yoshiko Okazawa, and Tomizo Tanaka (Kyoto Univ.). Acta Schol. Med. Univ. Kioto, 39: 57-63(Mar. 1964).

Dose-mortality curves of the AET (2-aminoethylisothiuronium Br.HBr)-treated C57BL/6 mice showed that the protective action was more marked in females than in males and that AET decreased the slope of the dose-mortality curve in either sex. Interpretations on these curious effects are presented. Such a biological aspect of the protective action of AET may shed light on the mechanism of its action on mice. (auth)

8958 RADIOPROTECTIVE EFFECT OF AMINOCAPROIC ACID AND OF PANCREATIC TRYPSIN INHIBITOR IN RAT. A. Danysz, D. Kocmierska-Grodzka, S. Niewiarowski, and J. Prokopowicz ([Medical Academy], Bialystok, Poland). Bull. Acad. Polon. Sci., Ser. Sci. Biol., 12: 445-9 (1964)

The radioprotective effects of aminocaproic acid (EACA) and pancreatic trypsin inhibitor (PTI) against radiation sickness in rats were investigated. Preliminary results revealed an increase of antiplasmin and antitrypsin activity after addition of both inhibitors to the plasma in vitro. Effective doses of both inhibitors, administered every 12 hr, were established. A radioprotective effect of EACA and PTI in the rat was proved by an increase survival of irradiated animals treated with one of the two substances, a short time before irradiation. It was concluded that further administration of the EACA did not increase the radioprotective effect. (P.C.H.)

8959 THE EFFECT OF A SINGLE LOCAL IRRADIATION ON THE PERIPHERAL VESSELS AND THEIR REACTION TO THE ADMINISTRATION OF ADRENALIN. O. V. Mikhailova (Kazan Medical Inst., USSR). Bull. Exptl. Biol. Med. (USSR) (English Transl.), 57: 158-60(Feb. 1964). Translated from Byul. Eksperim. Biol. i Med., 57: 38-40(Feb. 1964).

The perfusion method was used to study the reaction of the vessels in the rabbit ear, isolated on the 1st–4th day after local irradiation with a dose of 100 R. The effect was most pronounced one day after the irradiation, and was manifested by the disappearance of the spasm and dilatation of the vessels. In response to adrenalin administration, the vessels of the irradiated rabbit ear showed a more profound and more prolonged constriction than that seen in the control, followed by subsequent dilatation. (auth)

8960 THE PROPHYLACTIC EFFECT OF PHENOL AND PROCAINE ON RADIATION SICKNESS. J. Vanecek and V. Hlavaty. Casopis Lekaru Ceskych, 102: 295-6 (Mar. 1963).

From experiments on mice, it was found that repeated subcutaneous injections of phenol and procaine raise resistance to radiation sickness. Mice were injected over a period of 12 days, in three groups: control group: 0.05 ml of saline solution; 0.05 ml saline solution plus 0.1% phenol; and 0.05 ml saline solution plus 0.1% procaine. On the 15th day they were subjected to 650 R irradiation. Mortality in the control group was 55%; in the 2nd group, 38%; and in the 3rd, 32%. The results, which extend knowledge of the anti-shock effect of these substances, are discussed in detail (Schultz-Dale test, etc.). (Occupational Safety Health Abstr., 2: No. 5, 1964)

8961 MODIFICATION OF ANTITUMORAL IMMUNITY AFTER TOTAL IRRADIATION. EFFECTS OF CYSTAMINE. E. H. Betz and G. Booz (Université, Liège). Compt. Rend. Soc. Biol., 158: 1178-80(1964). (In French)

The effects of cystamine on the evolution of tissue immunity to tumor growth in the irradiated mouse was studied. Adult female mice were exposed to 450 and 750 R whole-body irradiation after a preliminary administration of cystamine. Animals were grafted with sarcoma J 24 hr after irradiation. The percentage of spontaneous regressions was determined as the measure of cystamine activity. The administration of cystamine preserved the antitumoral immunity of the mice that the x radiation inhibited. (J.S.R.)

8962 TREATMENT OF LEUKEMIA WITH RADIOPROTECTIVE SUBSTANCES IN COMBINATION WITH CHEMOTHERAPY. J. Bichel (Univ. of Aarhus, Denmark). Folia Clin. Intern., 13: 182-4(Apr. 1963). (In Spanish)

The possible selective protection of animals against nitrogen mustard (HN2) by means of cysteamine and other radioprotective compounds was investigated. The experiments were performed on inbred AKA* mice with a lymphocytic leukemia that occurs spontaneously in this strain. Also, after subcutaneous transplantation of 10^6 cells a local tumor develops and the animals soon die with generalized leukemia. Nearly 100% of the animals die between the 11th and the 13th day. In the dosage used (2 to 3 mg) cysteamine given in daily intraperitoneal injections caused some weight loss. By combination of this dose and a suitable HN2 dose an appreciable increase of the survival time of transplanted mice could be obtained. Similar results were achieved by pretreatment of the animals with L-cysteine. Animals that received combined cysteamine and HN2 treatment died much later with generalized leukemia. Other experiments showed that cysteamine increased the tolerance of the animals to Endoxan and that administration of cysteamine may increase the therapeutic results of Endoxan under suitable experimental conditions. AET was also used in the same type of experiments, but its protective effect against HN2 was less than that of cysteamine. It is suggested that the mechanism of protection against HN2 and against ionizing radiation are not identical. The cysteamine protection against HN2 may be on a cellular level while its protection against ionizing radiation may not be. It was also found that addition of cysteamine to Earle's strain L-cells and subsequent washing of the cells give a distinct protection of the cells against HN2 assessed by daily counting of cells but no protection against ionizing radiation. (TCO)

8963 PROTECTIVE EFFECTS OF CYSTEAMINE AND CYSTAMINE ON THE IRRADIATED RAT. J. Maisin, A. Dunjic, and P. Couvreur (Université, Louvain, Belg.). J. Belge Radiol., 47: 755-71(1964). (In French)

In rats, the toxicity of cysteamine and cystamine are about the same after peritoneal administration; after oral administration it is reduced by a factor 2.9 for cysteamine and 8.1 for cystamine. For a maximal tolerable dose of cysteamine and cystamine, the optimal moment of intraperitoneal administration lies immediately before irradiation. The x-ray dose reducing factors are 1.26 and 1.21, respectively. For the same protectors, the optimum moment for oral administration lies between 30 and 60 minutes before irradiation. In spite of oral administration of higher doses a limit of protection is attained, the dose reducing factor does not exceed 1.08. (auth)

8964 OPERATION FOLLOWING WHOLE-BODY X-IRRADIATION AND ADMINISTRATION OF A RADIATION PROTECTOR SUBSTANCE. PRELIMINARY REPORT: EXPERIMENTS IN DOGS. C. H. Schweikert, H.-A. Ladner, and I. Hess. Med. Klin. (Munich), 59: 734-5(1964).

A study was made of the effect of a radioprotective substance in acute radiation disease after whole-body x irradiation, during experimental transplantations of the trachea and bronchial tree. Dogs were given pyridoxal-5'-phosphate, the active form of vitamin B_6. The survival rate of dogs treated with a lethal radiation dose was distinctly increased by the vitamin; the survival rate of dogs treated by other operations was also significantly higher. (Excerpta Med., Sect. 23, 1: (Nov. 1964))

8965 NEW TECHNIQUE OF BONE MARROW ASPIRATION FOR TRANSFUSION PURPOSES. G. Abbozzo, M. Maiello, and M. Donati (Centro per la Transfusione del Sangue e di Immunologia, Florence). Minerva Med., 53: 2397-8(Aug. 18, 1962). (In Italian)

Because of the importance of bone marrow grafting in the treatment of radiation disease and other diseases, such as aplastic anemia and leukemia, affecting the hematopoietic system, improved methods of obtaining bone marrow were sought. This method is especially applicable to homografts in humans. The subject is premedicated intramuscularly with one mg of atropine and 5 mg of morphine 30 min prior to intervention. Aspiration is performed under general intravenous anesthesia with Methitural in varying dosage from subject to subject, fluctuating between 0.30 to 0.50 g, followed by a dose of 2 mg of succinylcholine per kg body weight. After the patient loses consciousness he additionally received 2 ml of thiobarbituric acid and immediately afterwards a curarizing substance. At this point a Klima-type needle connected by plastic tubing to a 100-ml bottle, in which a vacuum was previously created, is inserted into the sternum for aspiration. The recipient's skin, tubing, and needle are covered with a film of water-repellent silicone. The intensity of aspiration can be controlled with Mohor or Pean type forcep clamping the tubing. The vacuum in the bottle should be sufficient to collect 40 to 50 ml of medullary blood in 60 min. If greater quantity is desired, the needle can also be injected into the iliac crest. This method provides for maximum sterility, elimination of coagulation, three times more rapid aspiration than the syringe method, anesthesia of short duration, no patient complaints of unpleasant sensation, and, finally, reduction of material necessary for aspiration. (BBB)

8966 SOME CONSIDERATIONS ON MECHANISM OF CHEMICAL PROTECTION. Shigetoshi Antoku (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi, 23: 221-4 (May 25, 1963). (In Japanese)

The protective effect of 2-mercaptoethylguanidine (MEG) in 8-week-old mice irradiated with 800 and 1000 R doses of x ray over short irradiation times was studied. Various time intervals between the injection of MEG labeled with ^{35}S and the irradiation were investigated, and the distributions of total ^{35}S-MEG, free ^{35}S-MEG, and bound ^{35}S-MEG in various tissues of the mice injected with a protective dose of MEG were studied. It was observed that the effectiveness of MEG in lethally and supralethally irradiated mice was almost equal within the range of the injection time from 5 to 30 min before irradiation. The ^{35}S-labeled MEG injected intraperitoneally was rapidly taken up into the blood, incorporated in various organs, then passed into excretory systems. Changes in free ^{35}S-MEG with time showed a similar behavior to that of total ^{35}S-MEG. A direct relation between the protective effect of MEG and the content of total, free, and bound ^{35}S-MEG in various organs was not observed. (BBB)

8967 INVESTIGATIONS ON CHEMICAL PROTECTION AGAINST RADIATION DAMAGE. Arun Kumar Sharma and Amiya Kumar Sarkar (Univ. of Calcutta). Phyton (Buenos Aires), 21: 47-53(1964).

Onion bulbs were irradiated or treated with chloral hydrate and hexachlorocyclohexane or first irradiated and then treated or, finally, first treated and then irradiated. Root tip squashes were cytologically analyzed. It was concluded that the cytological effects of x rays can be suppressed by hexachlorocyclohexane, but that the reverse is not true. On the other hand, x rays afford protection against cytological damage by chloral hydrate, but the reverse is not true. (auth)

8968 ON THE ROLE OF 5-HYDROXYTRYPTAMINE (SEROTONINE) IN THE PATHOGENESIS OF HEMATOLOGIC TROUBLES IN ACUTE, IRREVERSIBLE IRRADIATION SICKNESS. EXPERIMENTAL STUDIES. Jozef Panasewicz, Stanislaw Lopaciuk, and Feliks Lubiarz (Inst. Hematologii, Warsaw). Polski Tygod. Lekar., 16: 1270-4 (1961). (In Polish)

Measurements of the blood serum 5-hydroxytryptamine content in dogs exposed to a single whole-body dose of 600 R x radiation showed a decrease to almost zero by the 10th day. The average survival time was 11 days. A sharp fall in the blood platelet count and prolongation of bleeding time was also noted. Studies in mice showed that 1 to 5 mg/animal of serotonin given 5 min. before or after irradiation prevented the symptoms of radiation sickness and increased survival time. Mice that survived for 30 days were apparently normal after 6 mo. A slight protective effect against radiation injuries in mice was observed after the administration of 0.5 mg of lysergic acid diethylamide. (C.H.)

8969 MODIFICATION OF THE RADIOSENSITIVITY OF THE CROCKERS SARCOMA 180 BY CHEMICAL PROTECTION (STUDIES CARRIED OUT WITH THE HELP OF ^{32}P). G. Gasso, A. Billitteri, and S. Romeo (Universita, Catania, Italy). Radiobiol. Latina, 6: 507-19(Oct.-Dec. 1963). (In Italian)

Mice with Crockers sarcoma 180 were used to investigate the modification of the tumor radiosensitivity following protection of the animal with intraperitoneal injection of cysteamine and AET just prior to irradiation. The protective effect was evaluated by determining the incorporation of ^{32}P in the tumors DNA and RNA. A high degree of protection was shown by cysteamine and AET on Crockers sarcoma 180. (auth)

8970 PRELIMINARY EXPERIMENTAL TESTS OF POSSIBLE ANTILEUCOPOIENIC ACTION OF LYSOZYME ON PANIRRADIATED RATS. C. Martinenghi, I. M. Stoppa, and G. Agati (Università, Milan and Università, Turin). Radiobiol. Latina, 6: 567-76(Oct.-Dec. 1963). (In Italian)

The possible influence exerted on the leucocytes and particularly on leucocytosis after leucopenia induced by lysozyme is compared with other drugs stimulating leucopoiesis. The animals (Norwegian albino rats) were divided into five groups. All the animals have undergone panirradiation with a single 250 R dose and some 72 hours later have received an intraperitoneal injection of 50 mg/kg of cyclophosphamide. The first group was kept as a control; the second has been injected with lysozyme; the third with ascorbic acid, the fourth with albema and the fifth with steranabol. Both in the group injected with lysozyme and in the other three groups treated with ascorbic acid, albema, and steranabol, the recovery of leucocytes is already evident some seven days after the intraperitoneal injection of cyclophosphamide and shortly values very near to the norm are reached; conversely, in the control group the values after 12 days reach only about 60% of the normal values. The analysis of the behavior of leucocytes and granulocytes shows that, whereas in the control group and in groups treated with ascorbic acid and albema, there exists a parallel recovery of leucocytes and granulocytes, in groups treated with steranabol and lysozyme this recovery affects prevalently the granulocytes. (auth)

8971 EFFECTS OF HYDROXYLAMINE ON THE GROWTH HALO OF IRRADIATED PRIMARY EXPLANTATES. G. Poggi Longostrevi and A. Squassabia (Università, Milan). Radiobiol. Latina, 6: 587-99(Oct.-Dec. 1963). (In Italian)

The effects of hydroxylamine on the area of growth and on the morphological aspect of the growth halo of primary explantates irradiated with 2500 and 5000 R doses were investigated. It was shown that this substance may lead both to a greater inhibition of growth and induction of morphological alterations more extensive in the outgrowth cells than in the irradiated controls. The results obtained are discussed based upon the possible interference of the substance not only on the mytotic process but further on cell migration. (auth)

8972 DRUG-INDUCED MODIFICATIONS OF THE RESPONSES OF THE ORGANISM TO RADIOLESIONS. INHIBITION OF THE CNS AND ENDOCRINE STIMULATION. PRELIMINARY RESULTS. B. Roseo and G. Poggi Longostrevi (Ospedale Maggiora, Milan). Radiobiol. Radioterap. Fis. Med., 18: 72-7(Jan.-Feb. 1963). (In Italian)

An experiment was performed to determine the influence of the central nervous system (CNS) and the hypophysial-adrenal axis over lesions due to whole-body irradiation. Rats were treated over a 4-day period with retarded-action ACTH (4 IU/kg/day) and Luminal (20 mg/kg/12 hr), and 24 hr after the beginning of this treatment the animals were irradiated with 800 R of 220-kv x rays. The rats used as controls received the same dose of irradiation, but were not pharmacologically treated. During the first 10 days following irradiation, a decrease of body weight, more evident in the drug- and hormone-treated animals, was observed, but after this period, the irradiated group showed a tendency to recover, whereas the controls showed deterioration of their general condition and loss of body weight. The percentage of surviving rats was higher in the pharmacologically treated rats (55% at 30 days compared with 10% in controls). The results confirmed previous reports in that, by stimulation of the hypophysis and depressing the CNS, it is possible to increase resistance to radiation. (BBB)

8973 RENAL HYPERTENSION SECONDARY TO UNILATERAL RADIATION DAMAGE RELIEVED BY NEPHRECTOMY. Andrew B. Crummy, Jr., Samuel Hellman, H. C. Stansel, Jr., and Peter B. Hukill (Grace-New Haven Community Hospital and Yale Univ., New Haven). Radiology, 84: 108-11(Jan. 1965).

A case of radioinduced renal hypertension is presented. Although both kidneys were irradiated, poor function and reduced blood supply were found only in the one that had received a higher dose. Nephrectomy relieved the hypertension. The importance of searching for unilateral renal disease in hypertensive patients who have previously received irradiation to both kidneys is emphasized. Unilateral renal damage may be a correctable cause of hypertension, even when many years have passed since the irradiation. (auth)

8974 PRESERVATION TIME OF FROZEN MOUSE BONE MARROW. Phan The Tran, M. A. Bender, Cao Xuan Chuan, and N. P. Buu Hoi (Office National de l'Energie Atomique, Saigon, Viet-Nam). Rev. Franc. Etudes Clin. Biol., 8: 589-92(June-July 1963). (In French)

Mouse femoral bone marrow, frozen at −30°, −79°, and −196°C, was injected in lethally irradiated (900 r) mice over a period of weeks. Marrow preserved at −196°C retained its viability after 126 weeks. That preserved at −79°C lost all regenerating capacity after 48 weeks and that at −30°C, after 4 weeks. Optimal temperatures for the preservation of animal cells are probably those below −80°C. Cell metabolism must be minimized. Even at these temperatures the deterioration of the cell probably continues, but at a reduced speed. (BBB)

8975 THE EFFECT OF 4Cl-TESTOSTERONE ACETATE ON RADIATION INJURIES IN PATIENTS WITH CANCER OF THE CERVIX. K. Masubuchi. Sanfujinka No Sekai, 15: 1105-13(Sept. 1963). (In Japanese)

8976 THE CONDITION OF THE MAXILLODENTAL SYSTEM DURING THE EXPERIMENTAL THERAPY OF RADIATION SICKNESS. A. A. Prokhonchukov and V. V. Panikarovskii. Sb., Teoriya i Prakt. Stomatologii, 6: 61-3 (1963).

In experiments on 108 white rats, the condition of the maxillodental system was studied during experimental therapy of acute and chronic radiation sickness with ACTH, selachyl and batyl alcohol, bofend (kaferid), and leukogen, separately and in various combinations. The animals were subjected to a single (700 R) or multiple doses (50 R 3 times a week, total dose 1450 R) of irradiation. After 30 days the animals were sacrificed, and samples were fixed in a 12% solution of neutral formalin and decalcified in 10% HNO_3, followed by embedding in celloidin. Sections were stained with hematoxylin-eosin. Under the conditions of acute irradiation, ACTH gave a pronounced therapeutic effect while the effect with selachyl alcohol was weak. A combination of bofend and leukogen gave a very good therapeutic effect during chronic radiation sickness. In this group of animals, the histologic picture of the maxillodental system was only slightly different from the normal. Use of selachyl alcohol in acute and chronic radiation sickness gave only an insignificant therapeutic effect. The use of combinations of batyl alcohol and leukogen or bofend gave a satisfactory therapeutic response in chronic radiation sickness. Comparative analysis showed that experimental therapy gives a more pronounced effect in chronic than in acute radiation sickness, which is characterized by a rapid development of degenerative changes in the tissues. (OTS)

8977 A REPORT ON THE TREATMENT OF SKIN AND MUCOUS MEMBRANE REACTIONS IN THERAPEUTIC PARTIAL-BODY IRRADIATION IN MEGAVOLT THERAPY (CLINICAL REPORT ON THE INVESTIGATIONS WITH TRIHYDROXYETHYLRUTOSIDUM). Johannes Klemm (Universität, Munich). Strahlentherapie, 125: 536-47(Dec. 1964). (In German)

The radioprotective effect of trihydroxyethylrutoside THR (substance Venoruton P4) on the mucous membrane of 300 patients who had received megavoltage therapy was investigated (150 controls). The first symptoms of a mucous membrane injury occurred at significantly higher focal doses. There were no damaging side reactions after the use of THR. (auth)

8978 THE RESTORATION OF IMMUNOLOGICAL FUNCTION BY THYMUS GRAFTING IN THYMECTOMIZED IRRADIATED MICE. E. Leuchars, A. M. Cross, and P. Dukor (Royal Cancer Hospital, London). Transplantation, 3: 28-38(Jan. 1965).

The recovery of the primary immune response in CBA mice given a potentially lethal dose of irradiation and syngeneic bone marrow therapy is very slow and incomplete if the hosts have previously been thymectomized. Restoration of the immune response can be obtained by grafting these mice with a single neonatal CBA/T6T6 or C3H thymus lobe. Mice given C57BL thymus grafts did not show such a marked restoration of immunological function. Histological investigation revealed that the CBA/T6T6 and the C3H grafts were accepted by the host but that the C57BL grafts failed to persist. Mice that received C57BL thymus grafts were found to be immune to C57BL skin grafts. (auth)

8979 PROTECTION OF X-IRRADIATED MICE BY "CLONED" HAEMOPOIETIC CELLS. Tamar Mekori and Michael Feldman (Weizmann Inst. of Science, Rehovoth, Israel). Transplantation, 3: 98-113(Jan. 1965).

The intrasplenic cloning method for bone marrow cells was applied to produce populations of defined cell types of bone marrow and spleen origin. The clones thus produced were found to consist of either erythroid, granuloid, or mixed (erythro- and granulo-) cell lines. No lymphoid elements were represented in the intrasplenic colonies. The immunological competence of such cloned cell populations was tested. No antibodies to red blood cell agglutinogens or to *Shigella dys.* antigen were formed by cloned cells, when tested after inoculation to x irradiated recipients. The application of Simonsen's test for the graft-versus-host response showed that cloned cell populations of either bone marrow or spleen origin are not capable of forming a detectable anti-host response. In view of their immunological deficiency, their capacity to confer protection on lethally x irradiated animals across genetic barriers was studied. It was demonstrated that cloned cells of parental strain origin can confer protection on irradiated F_1 hybrid recipients. The protective effect obtained—in contrast to lethal secondary disease produced by bone marrow cells of the same genetic origin—was attributed to the immunological incompetence of the cloned hemopoietic cells. The chimeras thus produced regained immunological reactivity, as manifested by testing them 3 months following treatment. Whether the cellular basis of this restoration is of host or donor origin was not demonstrated. The hemopoietic system, however, was found to have reverted to host type between the 2nd and 5th month following treatment. The possibility of avoiding the lethal secondary disease in allogeneic radiation chimeras by the application of cloned hemopoietic cells, is indicated and discussed. (auth)

8980 THE PROTECTIVE ACTION OF NICOTINAMIDE AGAINST THE RADIATION-INDUCED DEPRESSION OF DNA SYNTHESIS AS A CELL POPULATION PROBLEM. H. Hilz and H. Berndt (Universität, Hamburg). Z. Krebsforsch., 66: 155-64(1964). (In German)

Nicotinamide has been shown previously to protect glycolysis against the inhibitory action of radiation, apparently by suppressing the catabolism of diphosphopyridine nucleotide (DPN). Nicotinamide also appears to enhance the synthesis of DNA, a process that is also affected by irradiation. Further studies were conducted on Ehrlich ascites tumor cells to elucidate in role of nicotinamide on protection of DNA formation after irradiation. It was shown that when the tumor cells are irradiated, their DPN content, rate of glycolysis, and synthesis of DNA and protein are impaired, whereas respiration is only slightly affected. Nicotinamide prevents to a large extent these radiation effects when added to the incubation mixture. As revealed by autoradiographic analysis, the inhibition of DNA synthesis in such a nonsynchronously dividing cell population occurs in two ways. After 5000 r, most of the DNA-synthesizing cells completely lose the capacity to incorporate tritiated thymidine, whereas the remaining cells show a moderately impaired rate of uptake. When added after irradiation, nicotinamide restores the impairment nearly to normal by increasing both the number of DNA-synthesizing cells and the extent of labeling with thymidine in individual cells. These results confirm the important role of an adequate intracellular level of nicotinamide for the metabolism of certain tumor cells and for resistance to ionizing radiation. (BBB)

Radiation Hazards and Protection

Refer also to abstract 10666.

8981 X-RAY HAZARD IN SMALL-ANIMAL VETERINARY PRACTICE. Arthur Schmidt (Ontario Dept. of Health, Toronto) and L. B. Leppard. Can. J. Public Health, 55: 287-93(July 1964).

A tour of 10 small-animal clinics was undertaken to investigate radiation hazards that might be connected with the typical use of x-ray installations. Although a properly aligned and filtered x-ray tube is not a completely innocuous device, the hazard is small. A lead apron and gloves are likely to prevent acute injuries, even in the case of moderately high workloads or of low workloads and less favorable technical conditions. The accepted practice of wearing lead gloves and apron indicates that the profession is aware of the radiation hazard to some degree. It is shown, however, that the omission of filtration, beam-limiting diaphragms, and cones could change a relatively harmless operation into a dangerous one, and that in practice conditions can easily arise where 0.25 mm lead (contained in the normal lead garment) would not prevent exposures in excess of the limit values recommended by such bodies as the International Commission on Radiological Protection. (auth)

8982 THE EFFECT OF A COMBINATION OF HIGH-FREQUENCY ELECTROMAGNETIC FIELD AND X-RAYS IN INDUSTRY. Ju. A. Osipov, R. N. Vol'fovskaja, T. P. Asanova, E. L. Kulikovskaja, T. V. Kaljada, and A. V. Sceglova. Giginena i Sanit., 28: No. 6, 35-9(June 1963).

Medical examinations and observations of persons exposed to the combined action of a high-frequency electromagnetic field and x rays during work (manufacture of electron tubes), revealed that by about 1 year after the harmful influences had been partly or totally removed, the workers' state of health had improved considerably (fewer objective complaints and neurodynamic disturbances; blood picture considerably nearer normal, etc.). This is considered as an indication that the symptom complex described previously (CIS 1220-1963, Bog Bpz Xov: mz) is to be attributed to the combined effect of high-frequency radiation and x rays. (Occupational Safety Health Abstr., 2: No. 3, 1964)

8983 OCCUPATIONAL HEALTH SUPERVISION IN PLANTS USING RADIOACTIVE THICKNESS GAGES. R. B. Il'ickij and A. N. Suhomlina. Gigiena i Sanit., 28: No. 6, 71-4(June 1963).

An investigation was made on two types of thickness gages using a ^{204}Tl or ^{90}Sr source, which were employed for the automatic measurement of metal sheet thickness in a tinning line and a strip mill. To prevent contamination of the strip and the workplaces the source window must be shock resistant. Machine operators must be protected from radiation by ensuring that they are kept at a safe distance from the source; to determine this distance, the β-radiation level was meausred at various distances from the source. Appropriate precautions must also be taken during repair and calibration of these gages (minimizing the exposure period, provision of a separate room, shielding the source, etc.). (Occupational Safety Health Abstr., 2: No. 3, 1964)

8984 THE OCCUPATIONAL HEALTH SIGNIFICANCE OF NATURAL RADIOACTIVITY IN MINING AND PROCESSING RARE METAL ORES, AND ITS PART IN THE DEVELOPMENT OF PNEUMOCONIOSIS. B. A. Kacnel'son, K. N. Kljacina, G. V. Belobragina, E. Ja. Girskaja, L. G. Babuskina, I. E. Okonisnikova, G. V. Semenov, and E. P. Panfilova. Gigiena Truda i Prof. Zabolevaniya, 7: No. 4, 3-9(Apr. 1963).

Medical examinations between 1960 and 1961, of miners engaged for 5 years in extracting rare metals yielding pyrochlore $((Ca, Na)_2Nb_2O_6(OH,F,O;))$ and silicate of zirconium $(ZrSiO_4)$, revealed no occupational pathological changes; nor were any radioactive lesions found in the blood of white rats to which two dust compounds were administered intratracheally over a period of 14 months, in the 1st, 4th, 5th, 9th, 12th, and 14th month. The cellular changes in the lungs produced the collagenous fibrosis expected, though in the later stages it was more advanced than is normal with other dusts containing the same amount of silicates and free silica. A study of the phagocytosis of white mice by peritoneal tests revealed further phagocytic degeneration. Thorough study of the positive effect of radioactivity on the development of pneumoconiosis is recommended. (TCO)

8985 STUDIES ON NATURAL AND SPECIFIC IMMUNITY IN URANIUM MINE WORKERS. H. Dominas-Kuczkowska (Therapeutic-Prophylactic Center, Kowary, Poland). Polski Tygod. Lekar., 17: 640-9(1963).

The sources, nature, and extent of the radiation exposure of workers in uranium mines are discussed preliminary to presentation of data on humoral factors in a series of uranium miners. To estimate individual exposure of the workers, the time, place, and type of work were noted; dust concentration, the uranium and radium concentration in the ore, and the concentration of radium and radon in the air were determined conimetrically and gravimetrically. The dosage of external radiation was measured with test films carried by the workers. The mean values found in the last three years in the mine are tabulated. Medical examination of the long-employed workers of the mine frequently revealed a peculiar clinical syndrome. One of the possible factors in etiology of the syndrome was a lowering of immunologic resistance in these workers. A slight increase of the erythrocyte count was observed in long-employed workers, which might be explained by their continued presence in an atmosphere with a decreased content of oxygen, and it could be viewed as a compensatory mechanism. Normal white blood cell counts were found but in the Schilling hemogram of the miners' blood a considerable increase in lymphocytes was present and leukopenia was therefore found. This may be explained by the continued action of small doses of ionizing radiation and by the toxic action of uranium to which the workers were exposed. However in comparison with the normal values accepted for healthy persons a decrease of albumin was observed and the level of β_2-globulin approached pathologic values. The observed clinical syndrome of decreased resistance could not be explained as due to quantitative changes in serum proteins. The results obtained lead to no explanation of the clinical syndrome of decreased resistance to infection in uranium mine workers, although the decreased level of isohemagglutinins, marked lymphocytosis, and the slightly higher values of β_2-globulins are possibly indicative of exposure to radiation or toxic radionuclides. (TCO)

8986 STUDY OF SPECIFIC AND INDIVIDUAL RESISTANCE TO IONISING RADIATION AMONG URANIUM MINERS. H. Dominas-Kuczkowska. Polski Tygod. Lekar., 18: 367-71(Mar. 4, 1963).

The effects of external radiation and internal contamination of the body as a result of the inhalation of air polluted by radon, its decay products, and radioactive dusts; as well as the toxic effect of uranium, radium, and particularly radon and its derivatives on various organs are discussed. The results of studies on the specific and individual resistance, under the influence of ionizing radiation, among 47 underground miners and 5 medical service employees belonging to the same organization are reported. The following are the examinations cited: chest x rays; urinary analyses; hemoisoagglutinin levels, complete and incomplete; hematological analysis of blood protein. While results do not justify the conclusion that the resistance to radioactive contamination is lower, the hemoisoagglutinin decrease, the distinct lymphocytosis and slow increase in β_2 globulins are nevertheless held to be characteristic symptoms of prolonged minimal doses of ionizing and uranium radiation. (Occupational Health Safety Abstr., 2: No. 3, 1964)

8987 THE EFFECT OF THE NATURALLY RADIOACTIVE ELEMENTS OF THE URANIUM AND RADIUM GROUP ON THE HEMOPOIETIC SYSTEM OF THE URANIUM MINERS. Halina Dominas-Kuczkowska, Janina Bogulawska-Jaworska, and Wanda Dobryszycka (Therapeutic-Prophylactic Center, Kowary, Poland). Polski Tygod. Lekar., 18: 561-3(Apr. 15, 1963). (In Polish)

Studies on the hematopoietic system of the workers in a U mine were performed. Fifty three miners were examined; the control group consisted of eight workers of the Health Service employed in this mine. The following tests were performed: peripheral blood picture, reticulocytosis, erythrocyte size, Price-Jones curve, hematocrit, blood platelets count, bleeding and coagulation time, the occurrence of Hb F and Hb A_2, and of other Hb fractions. The miners were divided into three groups according to their period of employment: the first group consisted of miners employed for less than six years, the second group of miners working 7 to 10 years, and the third group who had been working in the mine over 10 years. A significant decrease of the polynuclear leukocyte count, increased lymphocytes, and prolonged coagulation time were seen in all these groups when compared with the controls. No significant differences among the three groups according to the period of employment were observed. (BBB)

8988 OCCUPATIONAL HAZARDS IN THE USE OF Au^{198}. J. Kudrna and A. Cernohorsky. Pracovni Lekar., 15: 294-7(Sept. 1963).

Gamma-radiation dose rates measured during the medical application of colloidal ^{198}Au, i.e. during the preparation and decanting of the colloidal solution (30-40 mR/h) and during intraperitoneal administration to the patient are reported. In addition measurements were made of the doses to which hospital personnel were exposed while attending patients who had been treated with ^{198}Au or while carrying out post-mortems on patients who had died shortly after treatment. It was concluded that in view of the short exposure time the radiation dose is tolerable, but it is emphasized that personnel handling radiosotopes should be given thorough training. The practice of administering radioactive isotopes to moribund patients is criticized as the decontamination of corpses is complicated and requires special precautionary measures. (Occupational Safety Health Abstr., 2: No. 6, 1964)

8989 THE SITUATION OF PERSONNEL MONITORING IN THE GERMAN DEMOCRATIC REPUBLIC. W. Kraus (Staatliche Zentrale fur Strahlenschutz, Deutsche Demokratische Republik, Berlin). Radiol. Diagn., 5: 647-55(1964). (In German)

Following a critical assessment of accuracy and significance of radiation doses determined by film dosimeters some results of the central personnel monitoring in the GDR are communicated. Moreover, the results of monitoring in 1962 are considered more detailed and compared with the results from 1957 to 1961 the problem set in with the medical use of ionizing radiation being especially regarded. Altogether the results of monitoring reflect an improvement of the work done in radiation protection although some problems have not been solved just in the medical field, for instance in the application of radium and in x-ray controls during surgical measures. It is pointed out that all persons working with ionizing radiation in medicine are to be monitored in order to determine the contribution of this group of population to the genetically effective dose to the total population. Besides the direct protection of the individual from somatic injuries this is the second important task of personnel monitoring. (auth)

8990 CHANGES IN PERIPHERAL BLOOD PARAMETERS IN SUBJECTS EXPOSED TO IONIZING RADIATIONS. Mario Maggio and Vito di Donfrancesco (Servizio Sanitario Nazionale per la Prevenzione degli Infortunati, Rome). Rass. Med. Ind., 32: 358-9(May-Aug. 1963). (In Italian)

A group of 45 persons who were occupationally exposed to radiation was studied during a one-yr period in an attempt to determine the relation between the dose of irradiation received and hematologic changes. The measurement of the dose absorbed was made by filtering the radiation through copper foil of different thickness and reading the density of a photographic film. The radiations received were measured during 13 consecutive work-weeks and, at the end of the year, the total dose received by each worker was calculated. Every three months each person submitted to a complete physical examination, including red and white cell counts and evaluation of the fibrin and hemoglobin levels. During the year only six persons received doses equal or superior to 5 Rem, and the serial blood tests showed that only three subjects that received doses of less than 5 Rem, on just one occasion, showed values under 3.5 million red cells and 12,000 leukocytes. These values were established as critical levels for radiation workers. The results analyzed statistically showed that the difference between the groups was only significant in regard to lymphocytes (P between >0.05 and <0.02). It is evident that with the limited number of subjects studied and the short period of this survey, it was not possible to establish a definitive conclusion, but the increase in the number of lymphocytes agrees with previous experience which showed the existence of lymphocytosis in some persons exposed to radiation. (BBB)

8991 RADIATION PROTECTION AND THE USE OF RADIOISOTOPE CALIBRATION EQUIPMENT IN THE PULP AND PAPER INDUSTRY. R. Lehner. Sichere Arbeit, 16: 5-10(1963).

In the manufacture of paper webs, beta radiation is used to measure basic weight, thus necessitating measures of protection against radiation. Following a description of measuring procedure and of the various isotopes employed, a survey of the Austrian regulations on radiological protection is given, together with the recommendations of the International Commission on Radiological Protection (ICRP) (maximum permissible body burden; equipment standards; and staff training and supervision). Improper work methods, shielding, and identification of radioactive sources, as well as responsibility for protective measures, are also discussed. (Occupational Safety Health Abstr., 2: No. 5, 1964)

8992 LEUKEMIA AND IONIZING RADIATION. J. Libansky. Vnitrni Lekar., 9: 628-37(Sept. 1963).

A review is presented of present knowledge on the relations between acute or chronic radiation exposure and leukemia in humans. Examinations of persons who have been exposed to ionizing radiation during their work or have been treated or examined by means of x rays, radium, or radioisotopes are discussed. Out of 110 adults suffering from hemoblastosis whose cases were clinically followed for several years, no single case of hemoblastosis attributable to radiation was found. The need to search for other possible leukemogens is emphasized and recommendations that exposure to ionizing radiation should be avoided are made. (auth)

8993 VLIYANIE RADIOAKTIVNYKH VESHCHESTV NA POLOVUYU FUNKTSIYU I POTOMSTVO. (Effects of Radioactive Substances on Sexual Functions and Progeny). D. I. Zakutinskii, ed. Moscow, Gosudarstvennoe Izdatel'stvo Meditsinskoi Literatury, 1963. 243p.

Radioinduced physiological and morphological injuries to male and female gonads are discussed. Evidence is presented indicating that radiotherapy during pregnancy affects embryogenesis and delivery. Transmission of radioactive substances from mother to offspring during embryonic and post embryonic development and effects of such transmission are analyzed. Cardiovascular, central nervous system, and digestive tract anomalies produced by prenatal irradiation are discussed. Data are provided on the consequences of atomic explosions in Japan, where a great number of microcephalic children were born to women pregnant at the time of exposure. It is suggested that genetic effects of radiation in radiodiagnosis and radiotherapy should be considered. (R.V.J.)

8994 IONIZING RADIATION HAZARDS. E. Kaufmann. Schweiz. Bl. Arbeitssicherheit, No. 51, 20p.(Mar. 1963).

The applications of ionizing radiation and radioactive substances in industry from the point of view of the hazards facing employees who are called upon to handle radiation equipment and sources, including particle accelerators, and sealed and unsealed sources, are described. Protective measures to be adopted in various fields (industrial radiography for the inspection of materials or the testing of products; elimination of static electricity; use of luminous compounds), and techniques for determining the radiation doses absorbed by the human body are recommended. (auth)

8995 PODRECZNIK OCHRONY RADIOLOGICZNEJ. (Manual of Radiation Protection). R. Broszkiewicz, Z. Jaworowski, T. Musialowicz, Z. Smal, and Z. Szot. Warsaw, Wydawnictwa Naukowo-Techniczne, 1963. 281p. 45 zlotys.

The main principles of nuclear physics are discussed and the structure of the atom, and the origin and nature of radiation are described. Information is also included on; biological effects of ionizing radiation; biological, cytological, and genetic changes in man; radiation injury; internal contamination; maximum permissible doses; radiation protection; disposal of radioactive waste; transport of radioactive substances; recommendations on radiation protection; and the design and layout of nuclear physics' laboratories. Special attention is given to principles of radiation protection as applied in Poland. (TCO)

Radiotherapy and Radiodiagnosis

Refer also to abstract 10096.

8996 (NP-tr-1190) THEORETICAL PRINCIPLES AND FIRST PRACTICAL RESULTS OF USING A RADIOACTIVE CONTRAST MEDIUM (LIPIODOL F ^{131}I) BY THE

LYMPHATIC ROUTE. S. Chiappa. Translated by O. S. Whitston (U.K.A.E.A. Research Group. Harwell, Berks, Eng.), from Minerva Nucl., 7: 460-7(1963). 19p. Dep. (mn); $1.10(fs), $0.80(mf) JCL

Therapeutic uses of an oil-based medium containing ^{131}I for the treatment of localized primary or secondary lymph node neoplasms is described. The oil medium, called Lipiodol fluid, and not defined, was developed originally for use as a contrast medium for use in radiography of the lymph system. Results are summarized for 128 patients with metastasis from tumors of the uterus, bladder, prostate, and cutaneous tumors of the lower extremities treated with ^{131}I-Lipiodol. A considerable decrease in the size of the lymph node treated was evident in some cases within a few days after introduction of the ^{131}I-Lipiodol. General symptomology was also improved and frequently a drop in fever, decrease of itching, and remission of abdominal pains were observed within 24 hr after injection of the radioactive contrast medium. (C.H.)

8997 (NP-tr-1197) PRELIMINARY REMARKS ON THE STUDY OF RADIOACTIVE COLLOIDS. A. Chevallier. Translated by J. M. Jacobs (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.), from Minerva Nucl., 7: 439-41(1963). 7p. Dep.(mn); $1.10(fs), $0.80(mf) JCL

A description is given of the basic characteristics of radiocolloids on which their utility for diagnostic and therapeutic purposes depends. An indication is given of the criteria which should guide medical practitioners in selecting the technique for the utilization of radiocolloids and the colloidal preparations that are most suitable for the purpose in view. (auth)

8998 THE VALUE OF SCANNING WITH RADIOACTIVE IODINE IN THYROID DISEASE. H. E. Duggan and D. L. Weijer (Univ. of Alberta Hospital, Edmonton, Can.). Alberta Med. Bull., 29: 31-42(Feb. 1964).

Various aspects of the theory of thyroid scanning, instrumentation, techniques, and clinical applications are reviewed. At present there are three methods for obtaining a scan. The one illustrated here is the so-called dot method, which is gradually being replaced by the photo method. Dot scans are made by a stylus, which is mechanically coupled to the detector, tapping sharply against a piece of sensitized paper thereby relating the position of the marks with the incoming pulses from the detector unit. In the second method, the intensity of a light flash incident on an unexposed piece of x-ray film varies in the same relation as the incoming count rate. This method has two major advantages over the dot scan. Firstly, the background can be suppressed in order to give a clearer organ outline, and secondly, the blackening of the film is related exponentially instead of linearly to the incoming counting rate. This gives a better differentiation between areas of high and low uptake within an organ. Future scanning methods will be almost instantaneous and will be performed with multiple detectors and oscilloscope display. The technique of thyroid scanning with ^{131}I is described in detail and 16 scans are illustrated as examples of typical findings under normal and various pathologic conditions. (BBB)

8999 COMPLICATIONS FOLLOWING RADIATION THERAPY IN CARCINOMA OF THE CERVIX AND THEIR TREATMENT. H. L. Kottmeier (Radiumhemmet, Stockholm). Am. J. Obstet. Gynecol., 88: 854-66(Apr. 1, 1964).

Radioinduced injuries are described as occurring as a result of radiotherapy for cervical carcinoma in 3484 women. In cases receiving a full course of irradiation, a total dose of 3200 to 3500 R was delivered to the lateral pelvic wall from Ra and x ray over a period of 10 to 12 weeks. A five-year recovery rate of 54.2% was attained. Fistulas immediately following operation were more frequently seen in cases in which a full course of irradiation was administered previously. Such complications occurred in 12 out of 53 cases treated by radical hysterectomy and in 72 out of 277 cases in which an electrosurgical procedure was carried out. Reirradiation or an operative procedure evidently makes the tissue more vulnerable and, consequently, contributes to late radiation damage. Late complications from radiation occurred especially in the bladder, lower sigmoid, and rectum. Bladder complications were less frequent than rectal complications. Rectal injuries occurred in 2.4%, bladder injuries in 1.4%, and ureteral obstruction in about 1% of the cases. (TCO)

9000 MALIGNANT TUMORS OF THE NASOPHARYNX. Gilbert H. Fletcher (Univ. of Texas, Houston) and Rodney R. Million. Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 44-55(Jan. 1965).

The adaptation of radiation techniques to the anatomic routes of spread in patients with malignant tumors of the nasopharynx without previous treatment is discussed. All patients studied had positive biopsy specimens from the nasopharynx. Radical comprehensive radiotherapy of both the primary lesion and neck lymph nodes yielded a survival rate of 35 to 40% in patients with malignant tumors of the nasopharynx. The survival rates did not vary significantly for the various histologic categories of the disease. A significant number of patients with neck lymph node metastases, even bilateral, have been salvaged. The geometric plan must be adapted when extensions of the disease are present. The final tumor dose is determined by the tumor bed (bone, cartilage, nerve sheaths) and the size of the masses. (P.C.H.)

9001 DOSE-TIME RELATIONSHIPS IN CANCER RADIOTHERAPY. A CLINICAL RADIOBIOLOGY STUDY OF EXTREMES OF DOSE AND TIME. J. Robert Andrews (National Cancer Inst., Bethesda, Md.). Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 56-74(Jan. 1965).

Histological aspects of the development of the dose-time concept and the radiobiological theory and experiments that are resulting in the changing ideas concerning it are reviewed. Clinical observations and results of radiotherapy in 2 selected groups of patients with cancer of the upper food and air passages treated by external beam radiotherapy at extremes of dose and time are reported. Information on the concept of the oxygen effect ratio is included as an addendum. 51 references are included. (P.C.H.)

9002 FEVER AS A COMPLICATION OF RADIATION THERAPY FOR CARCINOMA OF THE CERVIX. Martin Van Herik (Mayo Clinic and Mayo Foundation, Rochester, Minn.). Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 104-9(Jan. 1965).

A review was made of 260 cases of significant fever (over 100°F, orally) that occurred during radiotherapy of 1,666 patients who had carcinoma of the cervix. This is an incidence of 15.6%. The majority of fevers were of undetermined etiology (57%) or due to pelvic inflammatory disease (21%). Significant fever appeared to worsen the prognosis as evidenced by a 5 year survival rate for these patients of 37.3% as compared with 51.6% for all radiation treated patients with carcinoma of the cervix. Also, the prognosis became still poorer for those patients who experienced more prolonged febrile episodes. The 5 year survival was reduced to 25.8% if the total period of fever exceeded 7 days. In most patients the factors that precipitated fever were very probably trauma and manipulation incident to placement of the radium, which caused breakdown of the barriers holding in check an existing infection or inflammatory process or the cancer itself. It is stressed that efforts be made to refine treatment technique to reduce manipulation and trauma to a minimum in the radium therapy of cervical carcinoma. (auth)

9003 AN APPRAISAL OF RADIOACTIVE THERAPEUTIC LYMPHOGRAPHY. Edwin J. Liebner (Univ. of Illinois, Chicago). Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 110-21(Jan. 1965).

An appraisal of radioactive lymphography based on the use of ^{131}I ethiodol in humans and animals is presented. In therapeutic lymphography, the primary growth must metastasize in such a manner that intralymphatic injection can follow the possible spread of neoplastic cells in order to be of significant help. Of the three common sites for injection, lymphangiography of the foot is the easiest to perform. A study of 118 lymph nodes removed from 12 gynecologic cancer patients substantiated the concept that cancerocidal doses can be administered to the important lymph node regions. The possibilities and limitations of using the hand and neck sites for injection are mentioned. Clinically, radioactive lymphography is used primarily as an adjunct to established surgical and radiotherapeutic techniques. Preoperative radioactive lymphography has the advantage that unremoved metastatic lymph nodes will most likely have minimal disease and will respond to radioactivity. Prophylactic irradiation of the regional lymphatic system before detectable metastases occur may be the best use. Further progress in making the method more successful will depend upon the development of a technique for the neck and mediastinum. (P.C.H.)

9004 LINEAR ACCELERATOR SUPERVOLTAGE RADIATION THERAPY. CARCINOMA OF THE BLADDER. Robert H. Sagerman, Malcolm A. Bagshaw, and Henry S. Kaplan (Stanford Univ., Palo Alto, Calif.). Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 122-7(Jan. 1965).

Experience with linear accelerator supervoltage Roentgen therapy in 196 patients treated in a uniform manner for carcinoma of the bladder is reported. It was found that a significant number of patients with carcinoma of the urinary bladder may be cured with this type therapy. Advantages of the method are listed. (P.C.H.)

9005 IRIDIUM 192 AS A RADIUM SUBSTITUTE. Norman Simon (Mount Sinai Hospital, New York). Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 170-8(Jan. 1965).

The advantages of ^{192}Ir as a radium substitute are discussed. Several case studies are presented. ^{192}Ir represents an appreciable advance and advantage over radium for implantation of tumors. Its flexibility expands the indications for implants, for the radioactive material is in plastic tubing which can be sewn into accessible lesions. Accuracy of placement of the ^{192}Ir is superior to radium, for the implants are made with radioactively inert ends of the implant material. Along with increase of accuracy, there is less radiation exposure to the radiotherapist. (P.C.H.)

9006 A NOTE ON THE DOSIMETRY OF TANTALUM 182 WIRES. Kalevi Kettunen, P. I. Tuovinen, and E. Vauramo (Maria Hospital, Helsinki). Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 179-82(Jan. 1965).

An attempt was made to demonstrate that accurate physical dosimetry does not in itself yield a biologically meaningful result. Moreover, the roentgen unit was replaced by a biologic characteristic, viz., the progression of the necrosing area as a function of time-dose relationship. This procedure was adopted in the Maria Hospital when tantalum-182 wires are employed for radiotherapy. (auth)

9007 THE POTENTIALITIES FOR FAST NEUTRON BEAM RADIOTHERAPY. J. Robert Andrews (National Cancer Inst., Bethesda, Md.). Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 190-5(Jan. 1965).

Experience with fast neutron beam cancer radiotherapy was re-examined and reinterpreted in the light of contemporary neutron physics and cellular radiation biology. Such a reinterpretation suggests physical and radiobiological reasons for both the undesirable radiation effects and, also, the desirability of mounting additional fast neutron beam human cancer radiotherapy studies, especially with 14 Mev monoenergetic neutrons. Finally, the present status of both neutron physics and radiobiological concepts permits a reexploration of the usefulness of fast neutron beam human cancer radiotherapy with the probable elimination of some of the risks and undesirable sequelae that have been encountered. (auth)

9008 RADIATION HEPATITIS. John A. Ingold (Univ. of Michigan, Ann Arbor), George B. Reed, Henry S. Kaplan, and Malcolm A. Bagshaw. Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 200-8(Jan. 1965).

The clinical features of radiation hepatitis, a hitherto unreported complication of irradiation of the entire liver, are discussed. The principal manifestations are hepatomegaly and ascites, often accompanied by jaundice. There is concomitant deterioration of liver function. The condition may be transient and may require little therapy, or terminate in death due to hepatic insufficiency. The human liver, therefore, should not be regarded as a radioresistant organ. Histologically, the acute effects of radiation are those of centrolobular hemorrhage and sinusoidal congestion with adjacent minimal hepatic cellular atrophy. The late or chronic changes are less distinct, but do show more hepatic cellular damage and changes of the central vein walls. There appears to be a relationship between increasing doses of irradiation and the incidence of liver changes. Doses of 3,000-3,500 Rads to the entire liver in 3 to 4 weeks seem relatively safe. (P.C.H.)

9009 TELERADIOPELVIMETRY: A MODERN METHOD OF RADIOLOGIC PELVIMETRY DEVELOPED AT THE L. MANGIAGALLI CLINIC. Ennio Zanetti, G. Franco Rossi, and Luigi Tosca (Università, Milan). Ann. Ostet. Ginecol., 83: 377-86(Apr. 1961). (In Italian)

An improved method was developed for measurement of pelvic parameters in pregnant women which allows a reduction in the radiation exposure of the fetus and the maternal gonads. This so-called teleradiographic method is theoretically simple but introduced serious technical problems. Hard radiation is used to reduce the exposure time with low milliampere values, avoiding a blurring of the image and lowering the dose administered to the patient. One problem pertaining to teleradiopelvimetry is that the images proved to be slightly enlarged as compared with the anatomic parts. A formula, therefore, was used to calculate the actual dimensions of the radiographed objects with an insignificant mathematical error. The second problem introduced by the technique was that the bone-tissue contrast is not very sharp. Radiography is conducted with the patient assuming an upright position in relation to the x-ray machine which is located at a distance of three m from the focus of the tube, using an ultra-sensitive film and a Lysholm grid. The technical data are: 135 – 140 kv and 300 – 350 ma-sec. In the anterior-posterior projections the main pelvic parameters are indicated: maximum transverse dimension of the upper part of the pelvis, and the interspinal and intertuberous distances. The lateral projections provide the anterior-posterior marrow spaces. Two measurements are also provided of the fetus head: parietal and frontal-occipital. The correction factor in the anterior-lateral projections is based on the constant level method of Wolf and Loevinger in the lateral projections upon the pelvic lateral maximum diameter. Results obtained in the application of this method, teleradiopelvimetry, are considered promising for future developments in this field. (BBB)

9010 METASTASIZATION OF GUEREN'S CARCINOMA AFTER COMBINED IRRADIATION AND ADMINISTRATION OF β-MERCAPTOETHYLAMINE. M. S. Isaev (Roentgeno-Radiological and Oncological Research Inst., Kiev). Bull. Exptl. Biol. Med. (USSR) (English Transl.), 57: 82-3(Jan. 1965). Translated from Byul. Eksperim. Biol. i Med., 57: 85-7(Jan. 1965).

Peculiarities of metastasization of Gueren's carcinoma following irradiation of the pelvis for the primary tumor focus in the testicle, with protection against radiation by β-mercaptoethylamine, were investigated. The results demonstrated that irradiation of the pelvis with the use of β-mercaptoethylamine as well as without it, for a primary focus in the testicle depressed tumor growth and decreased metastasization. In a number of cases complete resolution of the tumor occurred in the sphere of x-ray action. However, the metastatic process was less pronounced in rats receiving β-mercaptoethylamine with subsequent irradiation of the pelvis as compared to the cases in which only irradiation was applied without using the radioprotective preparation. (auth)

9011 PREIRRADIATION. A. Zuppinger (Radiologisches Institut, Inselspital, Bern). Bull. Schweiz Akad. Med. Wiss., 20: 190-204(1964). (In German)

One argument that has been advanced in favor of preirradiation of tumors prior to their surgical removal is that it reduces the possibility of local, regional, or generalized metastasis. This is brought about by damage to the tumor cells themselves, production of edema in early stages of the tumor, and development of fibrosis in its later stages. Preirradiation also reduces the size of the tumor. Several arguments have been advanced against the use of preirradiation. The claim that it complicates the surgical operation is true only if it is carried out during the postirradiation hyperemic phase, or many months after an excessive radiation dose that induces fibrosis has been given. The claim that preirradiation increases the number of postoperative complications is true when very high radiation dosages are given previously. Theoretical considerations and practical experience have shown that there is no increase in metastases induced by preirradiation. Another argument used against preirradiation is that it has a psychological impact on the surgical intervention that follows. One reason for the psychic burden that is said to affect surgery carried out after preirradiation is probably the long interval of 6 to 8 weeks that is often permitted to intervene between these procedures. Operable tumors should be preirradiated in relatively small doses, and be followed by surgery within about 10 days. In comparison, inoperable tumors should be irradiated with relatively high doses, given over intervals of 4 to 6 weeks. (BBB)

9012 MEDICAL RADIATION TO CHILDREN WITH CONGENITAL HEART DISEASE. Dennis J. Vince. Can. Med. Assoc. J., 91: 1345-9(Dec. 26, 1964).

A retrospective analysis was made of the source of medical radiation received by 25 children who were investigated by cardiac catheterization techniques and followed in the Cardiac Outpatient Clinic of the Health Centre for Children, Vancouver General Hospital. The source of radiation was analyzed. The R dose per year received from plane films averaged 0.05 R, from cardiac fluoroscopy 6.7 R, and from catheterization and angiocardiography studies 1.58 R per year. In six of the 25 children, radiation doses to the thorax exceeded the LD_{50} for adult humans. In these six patients 95.8% of the radiation received was during cardiac fluoroscopy. Routine fluoroscopy for the radiological re-evaluation of pediatric patients with congenital heart disease should be replaced by plain chest radiographs. (auth)

9013 THE SEPARATION OF URANIUM ISOTOPES. Roberto Fiocchi (CNEN, Ispra, Italy and Universitat, Milan). Comit. Nazl. Energia Nucl., Notiziario, 10: No. 10, 19-23(Oct. 1964). (In Italian)

Problems in the separation of ^{235}U are briefly described. Recent developments on separation methods and progress made in the studies of gaseous diffusion separation are also discussed. (tr-auth)

9014 REDUCTION OF RADIATION EXPOSURE DURING AORTOGRAPHY AND ARTERIOGRAPHY BY DETERMINATION OF THE MOST FAVORABLE EXPOSURE TIMES WITH I^{131}. W. Schumacher and H. Witt (Rudolf-Virchow-Krankenhaus, Berlin). Fortschr. Gebiete Roentgenstrahlen Nuklearmed., 100: 516-19(1964).

A description is given of a simple method of determining the velocity of the blood flow with aorto- and arteriography. With its help it becomes possible to obtain optimal visualization of the blood vessels. Using routine investigations the radioactivity required was found to be 5 μC ^{131}I. This is equivalent to 1 to 2 mrad total body dose. Since radiography of the male pelvis results in a gonad dose of approximately 1,500 mrad, the significance of the reduction of radiation burden by avoidance of exposure errors becomes obvious. Without testing the velocity of the blood flow one has to reckon with about 10% misses. Furthermore by using the method a saving of films, contrast medium and time is also effected. (Excerpta Med., Sect. 23, 1: (Nov. 1964))

9015 ON THE OPTIMAL LOCAL IRRADIATION OF LARGE CERVICAL TUMORS. H. Kapp-Schwoerer and M. Busch (Universität Frauenklinik, Freiburg i. B.). Geburtsh. Frauenheilk., 24: 114-24(1964). (In German)

In treatment of large cervical carcinomas the radiation from Ra is too extensive to irradiate the entire tumor properly, and may produce fistulas or extensive damage to epithelial surfaces of adjacent organs. Seeding with ^{198}Au implants alone or with subsequent Ra treatment is a more preferable procedure. The seeds, encapsulated in 2.7 mm of Pb, have a γ energy of 0.411 Mev. Their half life is 93 hr, and the dose produced is 2.4 R/hr/mC at 1 cm distance. For small tumors 6000 R centrally located is the least dose necessary. For treatment of a large cervical tumor in a patient ten 12 mC seeds were implanted. While these were imbedded the patient received a deep x-ray therapy series, using four fields, with a focal dose of 2500 R, bilaterally from the parametrium to the pelvic wall. During the final third of the series a Ra implant was inserted into the tumor, which had regressed considerably by then. The Ra irradiation amounted to 1800 mg-hr, given to the intracervical and intrauterine regions. The patient became tumor free within less than two months. Compared to the usual Ra treatment, interstitial irradiation with Au seeds improves the dose distribution considerably. The pattern of dose distribution can be evaluated by electronic computer methods, since the positions of the seeds can be precisely determined by x-ray photographs. The isodose pattern from Au seeds is considerably more symmetrical than when Ra is used, and damage to healthy tissues surrounding the tumor is prevented. (BBB)

9016 BONE MARROW DOSE IN GASTRO-INTESTINAL X-RAY EXAMINATION. H. Yoshinaga, S. Antoku, and T. Yasuda. Hiroshima Igaku, 16: 806-9(Sept. 1963). (In Japanese)

9017 IMPROVEMENT IN RESULTS OF TREATMENT OF CARCINOMA OF THE CERVIX. L. S. Green and W. Muirhead (Hamilton General Hospital, Hamilton, Ont.). J. Can. Assoc. Radiologists, 14: 191-9(Dec. 1963).

Improved techniques for irradiation of cervical cancer, allowing for a higher 5-yr survival rate, are reported. Two groups of patients (681) were studied. In Group I, treatment usually consisted of a single Ra application and a course of external radiation therapy on a 220-kv unit using two large parallel opposed fields. In Group II, treatment included two Ra applications at an interval of one week. This was combined with a course of external radiation therapy by two pairs of anterior and posterior opposed fields (8 × 10 cm), with a 4 × 10 cm gap between the two anterior fields and a similar gap between the two posterior fields. This external radiation was almost always given on a ^{60}Co unit at a central dose of 4000 R in four weeks. The Meschan applicator is used; its normal Ra loading is illustrated. Where a full loading is possible, a dose of 7000 R is given at point A from the Ra. The isodose pattern from a typical full loading, using the Meschan applicator, is shown. The delivered dose at point B is calculated to be 1500 R. Since this point is at the center of the parallel opposed fields of external radiation, the total γ-ray dosage received at this point from Ra and ^{60}Co is 5500 R. The dose to bladder and rectum was measured at each Ra application using a direct-reading dose-rate meter. This was useful in understanding, and avoiding, undesirable reactions in bowel and bladder. These dosimeter studies showed the upper limits of tolerance of the bladder as 7000 R and of the rectum 5000 R. Dose readings at 30 points in rectum and bladder were taken at each application. This is considered as a high-dose Ra technique, probably higher than in most of the standardized techniques used in other centers; however, it resulted in a considerable increase in five-yr survivals with a tolerable occurrence of radiation sequelae. Radiation reactions and sequelae are described. Twelve cases in the whole of Group II had an acute radiation reaction following treatment. Ten colostomies and three small bowel resections were performed; one patient required cystectomy and one permanent cystotomy. Six of the ten colostomy patients had no diarrhea following treatment; this lack of correlation between the acute and the late reaction in other sites was also seen. It appears that the severity of the acute reaction may not be a good indication of the late radiation atrophy. There was one case of radiation fracture of the neck of the femur in each group. Experience with radical surgery as a means of rescuing postirradiation recurrences was not encouraging. The present five-year survival rate is now 62% in all cases and 83% in Stage I cases, which is considered excellent. (BBB)

9018 THE USE OF STRONTIUM-85 FOR THE DETECTION OF BONE LESIONS. Leonard Rosenthall (Montreal General Hospital). J. Can. Assoc. Radiologists, 15: 53-9(June 1964).

The results of the use of ^{85}Sr, a pure γ emitter, in 200 cases for the study of bone diseases are reported. Strontium-85 emits a single γ photon of 0.510 Mev and has a physical half life of 65 days. It is administered as $SrCl_2$ solution by the intravenous or intramuscular route. When the patient is to be scanned by an automatic scintillation scanner, 75 to 100 μC are given. Only 30 to 50 μC are necessary for external spot counting as the time can be increased to obtain adequate counting statistics. Estimated total body dose is 2.3 Rad per 100 μC injected. External counting was performed with a 5-cm straight-bore lead collimator associated with a 2 × 2 in NaI scintillation crystal. The crystal-skin distance is 15 cm and the end of the collimator is in contact with the body surface. Counting is performed at least one day after injection and generally not later than seven days. In a routine survey for metastatic disease, counts are obtained over the axial skeleton at 10-cm intervals, both sacroiliac joints, the hips, proximal femora, and both ankles. Other areas are counted when indicated, as in localized pain or a questionable bony lesion on the roentgenogram. Automatic scintillation scanning may follow if a more accurate localization is desired in a high activity region. The results of the investigation are presented in three parts: a determination of the normal range of ^{85}Sr uptake in the axial skeleton, cases demonstrating the use of ^{85}Sr for the detection of malignant disease in bone, and the concentration of Sr in the region of bone fractures and other osseous conditions. The normal range of concentration of activity was determined in the spine relative to the ankle and relative to itself, using the 10-cm level below the C7 vertebra as a reference point. The ankle ratios are necessary to distinguish diffuse spinal disease from normal. Since the fractional standard deviation is large (25%) compared to the 10-cm level ratios (11%), the latter values are necessary for detection of smaller increases in concentration. The technique was shown to uncover metastatic disease in the skeleton before it was seen on the roentgenogram. Other lesions stimulating an increased Ca turnover, and therefore ^{85}Sr uptake, are pyogenic osteomyelitis, tuberculosis, fibrous dysplasia, degenerative and rheumatoid arthritis, hyperostosis frontalis interna, Paget's disease, chronic sinusitis associated with osteitis, growing epiphyses, and surgical osteotomy. Some lesions of the ribs were missed; isotope detection is apparently improved where larger masses of osseous tissue are involved. (BBB)

9019 Tc^{99m} PERTECHNETATE FOR BRAIN SCANNING. J. C. McAfee, C. F. Fueger, H. S. Stern, H. N. Wagner, Jr., and T. Migita (Johns Hopkins Univ., Baltimore). J. Nucl. Med., 5: 811-27(Nov. 1964).

The applicability of ^{99m}Tc pertechnetate as an agent for brain scanning, tissue distribution in animals and man, and the relative merits of oral vs intravenous modes of administration are discussed. In a series of 133 patients ^{99m}Tc pertechnetate produced significantly better brain scans technically than the older agents ^{131}I albumin or ^{203}Hg chlormerodrin. It still appears however, that certain tumors frequently missed with older agents, such as low grade astrocytomas and suprasellar cysts, may be missed also with pertechnetate. The concentrations of this material in transplantable gliomas and normal brain tissues of mice were similar in magnitude to those obtained with the older agents. The superiority of the labeled pertechnetate appeared to be due entirely to its physical characteristics, i.e., essentially monoenergetic gamma emissions of 140 kev, absence of beta emission, and short physical half-life of six hours. These characteristics permitted the administration of relatively large doses of 10 mC and a significant reduction in the procedure time; yet the radiation doses were kept below the levels obtained with other agents. The radioactive preparation is easily obtained on a daily basis from a commercially available ^{99}Mo–^{99m}Tc generator. The intravenous mode of administration is preferred over the oral, although both methods of administration have been tried. The intravenous method produces more consistent results, somewhat higher count rates with the same amounts of radioactivity administered, and slightly lower fractions of the administered radioactivity are excreted in the feces. The oral route, however, may be preferred when immediate sterilization of the radioactive material cannot be carried out conveniently. By the oral route, satisfactory gastrointestinal absorption can be obtained in approximately 90% of all patients. Furthermore, with oral administration, pyrogen-free reagents need not be used, and the volume of the eluate is not critical. (P.C.H.)

9020 RADIOACTIVE HEPATOGRAPHY WITH Au-198. W. Sinner (Universität, Zurich). Med. Monatsschr., 17: 88-91(Feb. 1963). (In German)

The technique, applications, and hazards of the use of ^{198}Au in liver scanning are reviewed. (BBB)

9021 RADIATION DIAGNOSIS, RADIATION MEDICAL SCIENCE, AND RADIATION PROTECTION. [PART] II. Friedrich Ekert (Krankenhauses r.d. Isar, Munich). Muench. Med. Wochschr., 104: 1735-42(Sept. 14, 1962). (In German)

The effects of revision of current radiation control regulations will be to alter the costs of radiation treatment for patient, physician, and the hospital or clinic. Also, these will be closely affected by any alterations in radiation equipment or procedures that will be required for radiation protection. Several of the more recent studies of radiation protection, new methods of x-ray photography, applications of improved procedures for use of contrast media in cardiac studies, angiography, angiocardiography, splenoportography, and fistulography are reviewed. X-ray diagnosis of internal organs, such as lungs, pancreas, gastrointestinal tract, kidney, and ureteral tract is discussed. X-ray diagnosis of the skeleton for detection of metastases from bladder carcinoma is mentioned briefly. Approaches to diagnosis and treatment with radioisotopes are reviewed. These include uses of ^{131}I and ^{90}Y, Ra, and ^{198}Au. Radiation treatment of malignant tumors, radiation injuries, hazards, protection, etc. are briefly surveyed. The legal aspects of possible mutagenic effects of chemicals and radiation protection from radioactive materials in medical practice are discussed. (BBB)

9022 CYTOLOGIC RADIATION RESPONSE IN CERVICAL CANCER: A CRITICAL APPRAISAL, INCLUDING THE EFFECT OF SUPERVOLTAGE RADIATION. Margaret T. McLennan and Charles E. McLennan (Stanford Univ., Palo Alto, Calif.). Obstet. Gynecol., 24: 161-8(Aug. 1964).

Attempts were made to evaluate the Graham predictive test which is based on the radiation changes in normal host cells in a vaginal smear. Graham showed that those patients with cervical cancer whose cells showed an extensive radiation response (RR) had a much higher survival rate than those patients with less marked cellular responses. The development of the RR test for predicting survival in patients with carcinoma of the uterine cervix is reviewed, along with pertinent subsequent reports. The early data were compared with those from 10 other studies in which Graham's criteria were applied. A so-called good RR cell count was found in two-thirds of 1194 cases of Stage I and Stage II cancers, and 72% of these patients seemed to respond well to radiation. Of the remaining third with so-called poor RR, only 40% remained well for a significant time after radiotherapy. In a study of 99 women with invasive cervical cancers treated with a linear electron accelerator, 83 showed good RR. Of those with Stage I and Stage II lesions, 80% survive and are well 9 months to 6 years after, but 9 of 16 with poor RR also seem to have responded well to this radiation. Numerous inconsistencies in the findings and contradictions relating to the significance of the RR concept are found in the literature. Technical problems in preparation and interpretation of smears also add to the difficulty of assessing the value of the RR test as currently applied. It is concluded that the incidence of a good RR in normal host cells of women with cervical cancer is likely to be greater in a group of patients destined to respond favorably to radiation than in a group whose cancers will not be eliminated by radiation therapy. However, the predictive value of the RR test is not sufficiently great in any single instance to warrant offering it as a reason to abandon radiation therapy and to treat the patient by means of radical surgery. In its present state of development, the RR test for radiocurability is not recommended for routine clinical use. (BBB)

9023 THE APPLICATION OF QUINIRON (CHLOROQUINE PHOSPHATE) IN A CASE OF LUNG FIBROSIS CAUSED BY A POSTOPERATIVE X-RAY TREATMENT OF BREAST CANCER. Michio Yamamoto (Okayama Univ., Japan), Masatada Tanabe, Susumu Yamashaki, Kazuhide Watanabe, Masae Usami, and Motoki Funada. Okayama Igakkai Zasshi, 74: 703-5(Sept. 1963). (In Japanese)

A case is described of a 45-yr-old female government employee who was operated on for breast cancer in February, 1962. The patient was given postoperative radiation treatment, receiving 1200 R (400 R three times) one month after the operation, 4000 R over a one-month period one month later, and 4000 R over a 23-day period in August, 1962. This radiotherapy was directed toward the axilla and clavicle, the operated breast areas, as well as the pulmonary hilum area from a posterior angle in later fractions. The radiation therapy was halted during the fourth treatment as a result of the patient's complaint of light coughing, shortness of breath, and an oppressive feeling in the breast. The patient's roentgenogram in August showed a light fibrous shadow in the lower right lung, and much stronger fibrous shadow or opaque spots and heavier shadows in the hilum areas were seen in the November roentgenograms. Various tests ruled out the spread of cancer to the lung, however, and the pulmonary problem was diagnosed as resulting from fibrosis of the lung. The patient was given daily 375 mg of chloroquine for the treatment of lung fibrosis for several months, resulting in a marked improvement in the x-ray findings, in the recovery of lung function, as well as in the reduction of the symptom of breathlessness and a gain in weight. (BBB)

9024 DOSIMETRY IN RADIUM THERAPY OF UTERINE CANCER. L. Dalla Bernardina, L. Carletti, and P. Németh. Quaderni Radiol., 29: 167-83(1964).

Technical refinements in radium therapy are considered. Metal applicators are recommended for endocavitory radium therapy, for easier handling and more accurate dose administration. Several tables and illustrations are included. (Excerpta Med., Sect. 23, 1: (Nov. 1964))

9025 DOSIMETRY IN "RADS" FOR RADIUM THERAPY OF CANCER OF THE NECK OF THE UTERUS. G. Savino (Ospedale Maggiore, Novara, Italy). Radiobiol. Latina, 6: 497-505(Oct.-Dec. 1963). (In Italian)

Data on the physical and radiobiological basis of dosimetry in Rads of radium is used to describe the method adopted in the Institute of Radiology of the Novara Hospital. The doses in some points are evaluated with the mathematical method according to Patterson and Parker and direct dosimetry is performed for the bladder and rectum such as to avoid trespassing the tolerance limits of these organs. (auth)

9026 PERIODIC FRACTIONATION OF DOSES. G. Savino (Ospedale Maggiore, Novara, Italy). Radiobiol. Latina, 6: 629-43(Oct.-Dec. 1963). (In Italian)

Recent contributions of radiobiology and clinical studies to periodical radiotherapeutics are summarized. (auth)

9027 DOSAGE DISTRIBUTION IN THREE DIFFERENT METHODS OF TANGENTIAL MAMMARY IRRADIATION. S. Matschke, G. Nauber, K. Welker (Institut für Biologie und Medizin, Forschungsgemeinschaft der Deutschen Akademie der Wissenschaften, Berlin). Radiobiol. Radiotherap., 3: 565-72(1962). (In German)

For ideal tangential irradiation several requirements must be met. The dose used must be distributed uniformly for 2 or 3 cm below the skin surface. The dose gradient should fall off sharply at a depth of 3 or 4 cm, so that the adjacent underlying tissues will not be irradiated to any significant extent. In this way unnecessary irradiation of healthy tissues can be avoided. In effect, tangential irradiation focuses and concentrates radiation, and improves dose distribution so that only a layer ~3 or 4 cm deep is irradiated. Three types of tangential irradiation were studied. The first was a stationary field type, designated as the pincers method. The second was pendulum irradiation with a movable tube shield, where the dose max was located alternately in the axillary region and in the region of the sternum. These two types of tangential irradiation used 200-kv x rays. The third type of pendulum irradiation studies used a ^{60}Co unit where tilting was not possible, and the fields were superimposed on one another. (BBB)

9028 ON THE PROBLEM OF THE X-RAY DIAGNOSIS AND TELEGAMMA THERAPY OF MALIGNANT SKELETAL TUMORS. G. Hadzidedov and G. Mitron (Inst. for Specialization and Advanced Training of Physicans, "ISUL", Sofia). Radiobiol. Radiotherap., 3: 601-8(1962). (In German)

During the early stages of growth of malignant bone tumors, discrete alterations of the bone contours appear often. These include defects, spicules, periosteal spurs, and appositions, or isolated predominantly structural changes, such as necrosis or compactions. Distally tumor spicules are thin and regularly formed, while in other disorders they are sharp pointed and larger. They give a more comblike, fimbriated appearance. Their bases are somewhat broader and thicker, indicating a comparatively slower development process. The malignant tumor invading the soft tissue forms spiculae growing linearly and regularly, but that are not so sharply delineated. Skeletal hemoblastomas and lymphogranulomas, which develop very slowly, show spicular changes that are more structurally definite than are those of malignant tumors. Also, malignant bone tumors sometimes have uniform lamellar periosteal deposits. X irradiation can be used to differentiate between the spicules of malignant tumors and other diseases. In inflammatory processes the contour changes remain after treatment, but with malignant growths the contours are definitely altered. In some malignant tumors circumscribed striated areas of mottled porosity may appear. The x-ray films resemble those of beginning osteomyelitis, but show little periosteal reaction. Of 110 osteogenic tumors and 31 Ewing and reticulosarcomas, 98 were irradiated by telecobalt exclusively, and 43 were treated by surgery plus radiation. For the osteogenic tumors the focal dose was 6000 to 9000 R given in 6 weeks, and for the sarcomas 4500 to 6000 R was given. In most cases the pain subsided, tumor growth ceased, and the blood picture and general status improved. The histological changes produced by 6000 R irradiation of the sarcomas included chromatolysis and pyknosis of cell nuclei, protoplasmic vacuolization, cell atrophy, extensive fields of necrosis, and wide areas of lacunar bone resorption. At the tumor site and its periphery there was marked fibrosis and hyalinosis with vascular obliteration, indicating blockage of tumor elements and reduced possibility for metastasis. Of the osteogenic sarcoma and the Ewing sarcoma patients, 14 and 18%, respectively, survived for more than five yr. (BBB)

9029 CLINICAL VIEWPOINTS ON TELECOBALT IRRADIATION OF MALIGNANT GROWTHS IN THE MOUTH AREA. H. zur Horst-Meyer (Humboldt Universität, Berlin). Radiobiol. Radiotherap., 4: 49-55(1963). (In German)

Malignant growths in the region of the head are most easily treated with telecobalt irradiation, because its absorption through bone and soft tissue is more homogeneous than is conventional depth therapy. In contrast to the good skin tolerance observed in all patients, the reaction of the oral mucosa varies considerably. Essentially, radiogenic mucositis is less severe in toothless patients than in patients with partial or complete dentition. It is affected by several physical and biological factors. Among the physical factors that intensify mucositis is the presence of metal fillings, crowns, or bridges within the radiation beam. These should be removed, even if they are outside of the field irradiated. Pathogenic bacteria can increase mucositis. Treatment with radiation reduces salivary secretion. Reduction of secretion begins at ~3000 R, when the patient complains of thick, ropy saliva. At ~6000 R transient or permanent dryness can cause xerostomy. As a result of the radioinduced mucositis the patient avoids all solid foods and favors a soft diet. Both factors reduce the self-cleansing action of the mouth, and favors growth of pathogenic flora. In older patients with paradentosis this growth may be increased so much by inflammation of the tongue and oral mucosa that radiation treatment may have to be stopped. Presence of suppurative foci may also require that this be done. One factor that must be kept in mind is that radiation exposure reduces the capacity of the tissues to heal, and because of this there is some possibility of development of an osteomyelitis in extraction wounds. Therefore, extraction of all damaged teeth should be carried out before irradiation, because it would be inadvisable to extract any tooth from an intensely irradiated area. (BBB)

9030 ON STANDARDIZATION OF THE FOCAL DETERMINATION IN CALCULATION OF PENDULUM IRRADIATIONS WITH TELECOBALT EQUIPMENTS. W. Kraus (Universität Geschwulstklinik der Charité, Berlin). Radiobiol. Radiotherap., 4: 177-84(1963). (In German)

Frequently a simplified procedure is used in calculation of the dose from ^{60}Co γ irradiation with pendulum therapy. Radiation is directed from the point of rotation at equal angular intervals and envelops the body section to be treated. The average focal depth of these radiations is measured, and the total focal dose desired is calculated from these focal depths, just as for a stationary field. Naturally, it would be more exact to calculate the total focal dose for each beam as is done for a stationary field, for with the values estimated this way the actual focal dose would be obtained as an average value. Experience shows that, using a simplified procedure with a circular body section with the point of rotation in the center of the circle, the results deviate only very slightly from those obtained by the more exact method. The two procedures agree almost exactly with one another, with a considerable saving in calculation time using the simplified procedure. This study systematically compares the limitations of the variations between the two procedures. In order to make the calculations more convenient the body sections are assumed to be elliptical, and the rotation is assumed to be complete. Instead of estimating the average values by the more exact integral presentation the summing technique is used, because there is no analytical presentation for the relative depth dose, and because in actual practice the focal depths or total focal dose is really measured from multiple radiations from the point of rotation. (BBB)

9031 BEAM DIRECTION TREATMENT OF THE BLADDER USING GLASS-FIBRE REINFORCED PLASTICS. S. H. Crooks (Salterley Grange Hospital, Cheltenham, Eng.). Radiography, 29: 368-74(Dec. 1963).

An improved system of beam direction treatment of the bladder with the patient in the erect position is described. A fiberglass shell is used to provide an accurate field-tumor relation and by insuring that the bladder is empty of urine its position in relation to the shell does not vary, enabling each field to pass with mathematical precision through the treatment zone. Glass-fiber shells are strong yet light and thin; any degree of flexibility can be obtained, thus allowing the shells to be fabricated in one complete section. Accurate localization of the tumor zone is obtained by using a double contrast localizing technique, such as with carbon dioxide and a small marker at the base of the bladder. Air limited to a volume of 50 cm^3 could be used as a replacement for CO$_2$. Retained fluid could be demonstrated by the introduction of 5 ml of contrast media. Electromagnetic coupling of the shell to a gantry provided rapid, effective, and effortless immobilization of the patient. Advantages were gained by using an electromagnetic applicator/field coupling. The magnetic pull was sufficient to insure that each set-up was correct and remained so for the remainder of the treatment. For high-energy radiation, with the applicator taking the place of the air gap, its presence did not effect the radiation build-up. This type of field coupling can be used for any beam direction treatment where a shell is employed. The position of each radiation port was checked radiographically under treatment conditions to confirm the beam direction. The introduction of 50 cm^3 of air into the bladder at this state demonstrated the relation of the bladder to the treatment zone as its capacity is gradually increased. (BBB)

9032 COMPARISON OF RADIOPHOSPHORUS AND EXTERNAL WHOLE-BODY IRRADIATION IN THE TREATMENT OF POLYCYTHEMIA VERA. F. Bistolfi and E. Pignataro (Università, Genoa). Radiol. Med., 49: 1126-50 (1963).

It is generally recognized that treatment with radiophosphorus is clinically superior to external total irradiation in polycythemia. Therefore a dosimetric analysis was made of these two methods in space and time. It was found that a standard cycle of radiophosphorus administered intravenously (4.5 mc, interval of 12 weeks, 3 mc) corresponded to the integral dose absorbed by a patient of 70 kg treated with external γ-irradiation of 60 R. From a practical point of view total external γ-irradiation equivalent to this cycle of radiophosphorus would require a dose-time relationship of 60 R in 120 days (10 doses of 6R with intervals of 2 weeks). This scheme of treatment would also have the advantage (in comparison with external multiple field irradiation) of all hyperplastic foci under homogeneous chronotopical conditions. (Excerpta Med., Sect. 23, 1: (Nov. 1964))

9033 PROPOSAL OF A NEW SIMPLIFIED DOSAGE SYSTEM IN RADIOTHERAPY: BIODOSE FACTORS AND ISOBIODOSE CURVES. Franco Bistolfi (Università, Genoa). Radiol. Med., 50: 1026-51(Oct. 1964). (In Italian)

A new dosage system, extremely easy to use, which permits simultaneous study of time and space factors is presented. The units of measure of the system are the chronodoses (dose/time pairs) of Strandquist's erythema curve so that the chronodoses necessary for a given effect on normal and pathological tissues, may be expressed in terms of erythema chronodose (ECD) and become biodoses. The isoeffect curves are replaced by plain biodose factors (varying from 0.15 for cataract to 3 for necrosis of the skin) permitting the transformation of the isodose curves into isobiodose curves. (P.C.H.)

9034 THE THYROID SCINTIGRAM. I. THE HOT NODULE. J. Martin Miller and Joel I. Hamburger (Henry Ford Hospital, Detroit). Radiology, 84: 66-74(Jan. 1965).

Autonomous and thyrotropic-(TSH)-dependent hot lesions are defined and classified on the basis of physiologic criteria. Diagnosis of a hot lesion with TSH and thyroxine is discussed. The implication of an autonomous lesion (nodule) diagnosis in reference to the problem of malignancy in nodular goiter is also considered. As no proved case of a hot cancer that could be confused with a benign lesion has yet been reported, the theoretical possibility of its existence was examined. It was concluded that such a case is a theoretical improbability. (P.C.H.)

9035 THE ROLE OF STRONTIUM 85 IN THE DETECTION OF BONE DISEASE. Leonard Rosenthall (Montreal General Hospital, Montreal). Radiology, 84: 75-82(Jan. 1965).

In 300 patients ^{85}Sr bone uptake determinations by external scintillation counting were performed during a sixteen-month interval. It was found that any abnormality inducing an increased calcium accretion rate will be reflected in an increased ^{85}Sr uptake. Metastatic disease was detected before its presence could be visualized on the roentgenogram. A number of other osseous conditions, however, may be associated with an increased concentration of ^{85}Sr. Therefore, a thorough acquaintance with the clinical and x-ray findings is necessary for interpretation. The measurement of the normal range of ^{85}Sr uptake in the axial skeleton of 40 patients, employing both the ankle and various spinal levels as reference points, is reported. (P.C.H.)

9036 TOTAL-BODY IRRADIATION IN MULTIPLE MYELOMA. David L. Holder (Univ. of North Carolina, Chapel Hill). Radiology, 84: 83-6(Jan. 1965).

Twenty patients with painful myelomatosis were treated with whole-body irradiation. Approximately one-third received excellent pain relief lasting several months, one-third had partial relief, and one-third had no response. In the majority of patients nausea and vomiting developed. This was short-lived and easily controlled. A temporary leukopenia was observed in almost all patients, but no secondary complications were noted. Whole-body irradiation is thought to be a simple and effective mode of therapy for palliation of pain in patients with wide-spread multiple myeloma. (auth)

9037 A DOUBLE-HEADED FIXED BEAM TELETHERAPY MACHINE FOR LOW COST MEGAVOLTAGE THERAPY. Ulrich K. Henschke and Basil S. Proimos (Memorial Center for Cancer and Allied Diseases, New York and Greek Anticancer Inst., Athens). Radiology, 84: 122(Jan. 1965).

An arrangement that greatly lowers the costs of megavoltage therapy is described. Two identical treatment rooms are served from one double-headed machine mounted in the wall between two rooms. The teletherapy source, either ^{60}Co or ^{137}Cs, is in the middle in the off position and can be moved into either head by a steel cable operated manually by a control wheel. Automatic return of the source to the off position at the end of the treatment time is provided by a spring. While one patient is treated in one room, the next patient is set up in the adjoining room. Although the radiation beam is always directed straight down, experience has shown that the majority of radiotherapy patients can be satisfactorily treated with straight-down beams. The lack of mobility of the head in the design is compensated for by the possibility of using field sizes up to 45 × 30 cm at 70 cm source distance. (P.C.H.)

9038 COMPLICATIONS FOLLOWING RADIOTHERAPEUTIC TREATMENT OF UTERINE CERVICAL CANCER. Renato R. de Araujo Cintra, A. Francia Martins, Isidoro Dreicon, and Elme P. A. Garcia (Hospital A. C. Camargo, Sao Paulo, Brazil). Rev. Brasil. Cirurg., 45: 300-2(Apr. 1963). (In Portuguese)

Of 241 cases of cervical cancer treated exclusively by radiotherapy, severe complications developed in 6 cases, or 2.4%. The remaining complications were considered only as mild reactions, because they were temporary and disappeared following usual clinical treatment. Among the serious complications there were two deaths, one recto-vaginal fistula, and three cases of rectal stenosis. All patients received an initial treatment with intracavitary Ra following a modified Manchester technique, which utilizes a dose of 8000 R. In most cases this was supplemented by an external dose of 3000 to 4000 R in three to four weeks. The complications are described. (C.H.)

9039 THE ZUERICH IRRADIATION METHOD FOR CERVIX CARCINOMA WITH SPECIAL REGARD FOR THE DOSE DISTRIBUTION PER UNIT TIME USED. Jean H. Mueller, Felix Wachsmann, and Detlev Schuster (Universitäts-Frauenklinik, Zurich and Universität Erlangen-Nurnberg, Ger.). Strahlentherapie, 125: 502-23(Dec. 1964). (In German)

A short historical review is given on the current clinical-radiotherapeutic and physical-technical aspects of the Zuerich-irradiation method of carcinoma of the cervix. Special consideration is given to the time factor in the dose distribution used. The dose distribution can be considered as very favorable in regard to the high quality of the therapeutic results obtained and to special radiobiological observations as well. (auth)

9040 THE OSTEORADIONECROSIS OF THE FEMORAL NECK—A DOSE PROBLEM? Karl Grosse-Holz (Knappschaftskrankenhauses, Recklinghausen, Ger.). Strahlentherapie, 125: 591-8(Dec. 1964). (In German)

In 0.3% (13:4051) of gynecological cases, treated with radiation in the Knappschafts-Hospital in Recklinghausen, a radionecrosis of the femoral neck occurred. There were many individual variations, therefore, it is reasoned that endogenous factors may have a greater causal importance than the dosage amount. (auth)

9041 THE CHANGES IN SERUM PROTEIN FRACTION IN FEMALE CARCINOMA PATIENTS DURING RADIATION TREATMENT. Z. Kónya, S. Csoemoer, and J. Szeker (Univ. of Budapest). Strahlentherapie, 125: 599-603(Dec. 1964). (In German)

Paper electrophoresis of serum proteins was done in 33 female carcinoma patients during radiotherapy. It was found that after administration of higher doses, the albumin value and the A/G-ratio decreased, while an increase was observed especially in the α_1-, α_2-, and γ-fractions of the globulin portions. These changes increased with the radiation dose. Dysproteinemia observed in carcinoma patients increased during radiotherapy. To improve the conditions for radiotherapy, a special diet and parenteral protein administration are recommended. (auth)

9042 TREATMENT OF CHRONIC MURINE HOMOLOGOUS DISEASE: A COMPARATIVE STUDY OF FOUR "IMMUNOSUPPRESSIVE" AGENTS. Robert S. Schwartz and Lorraine Beldotti (Pratt Clinic-New England Center Hospital and Tufts Univ. School of Medicine, Boston). Transplantation, 3: 79-97(Jan. 1965).

Treatment of chronic homologous disease, induced in young adult $(C57BL/6 \times DBA/2)F_1$ mice by injections of C57BL/6 spleen cells, was attempted with four agents: 6-mercaptopurine (6-MP), prednisone, methotrexate and whole-body x-radiation. 6-MP caused acceleration of the disease, regardless of dosage or timing of administration. Prednisone ameliorated homologous disease only when given at the same time as the parental cells. Methotrexate treatment suppressed the disease only when given after the parental cells, at a time when active disease is ordinarily expected. Whole-body x radiation (400 R) led to extreme susceptibility to the graft-versus-host reaction, even if given 2 weeks before or 60 days after the parental cells. However, a period approximately 3 weeks after administration of parental cells was radioresistant in that no acceleration of the disease occurred. The accelerating effect of 6-mercaptopurine could not be reversed by administering isologous spleen cells. Amelioration of homologous disease by methotrexate was associated with the acquisition of durable specific immunological tolerance of host antigens by the injected parental cells. (auth)

9043 THE RADIATION REACTION AS A THERAPEUTIC INDICATOR IN STAGE I CARCINOMA OF THE UTERINE CERVIX. Renzo Grattarola and Luciano Luciani (Istituto Nazionale per lo Studio e la Cura dei Tumori, Milan). Tumori, 48: 99-107(Mar.-Apr. 1962). (In Italian)

Attempts were made to correlate results of the Graham radiation response (RR) test, based on the cytologic response of vaginal cells, in patients with cervical cancer treated with radium. The response was designated RR+ (positive) or RR− (negative). The three-year survival rate of 73 patients with carcinoma of the uterine cervix in Stages I, II, and III, treated by radiotherapy only, was correlated with the RR test. Twenty-seven (64.2%) of 42 patients who were RR+ and 9 (29%) of 31 patients who were RR− were alive at the end of the third year. A better survival rate in the RR+ patients was similar in all stages. In Stage I the survival rate was 83.3% in the RR+ cases and 57.1% in the RR– cases. In a second group of 27 patients in Stage I, in which radiotherapy was followed by a Wertheim radical hysterectomy, the three-yr survival rate was greater in RR– patients (84.6%) than in RR+ patients (64.3%). In a third group of 59 cases, no correlation between RR and lymph node metastases was found. The results suggest that the evaluation of the RR could be helpful in establishing the treatment of the carcinoma of the cervix Stage I. The RR+ cases show better results when treated by radiotherapy only, while the RR– cases are better treated by radiotherapy followed by radical surgery. The results are discussed in relation to parallel evaluations of RR by other investigators. (BBB)

9044 IZMERENIE I RASCHET POGLOSHCHENNYKH DOZ PRI VNESHNEM I VNUTRENNEM OBLUCHENII. (Measurements and Calculations of Absorbed Doses during External and Internal Irradiation). A. N. Krongauz, V. A. Petrov, G. A. Linchevskaya, and N. M. Palladiova. Moscow, State Publishing House of Medical Literature, 1963. 136p, 36 drawings.

Methods of measuring x- and γ-radiation doses used in therapy and diagnosis are discussed. Formulas and tables are given for calculating absorbed and integrally absorbed doses of ^{198}Au, ^{131}I, ^{32}P, and ^{24}Na. Descriptions are presented of the apparatus used for measuring local radiation absorption during external and internal irradiation. (R.V.J.)

CHEMISTRY

General

9045 (HW-83611) PROGRESS IN ACTINIDE ELEMENT CHEMISTRY. A Summary of Hanford Laboratories Achievements in This Program Under General Electric, 1956–1964. L. L. Burger (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1964. Contract AT(45-1)-1350. 23p. Dep.; $1.00(OTS)

Some of the major achievements resulting from fundamental chemistry studies on the actinide elements are summarized under the following headings: solvent extraction and ion exchange, molten salt chemistry, structure and coordination chemistry, and related studies. An extensive bibliography is included. (D.L.C.)

9046 (IS-900(Sect.C)) CHEMISTRY DIVISION. (Ames Lab., Ames, Iowa). 84p.

Research and development is reported on physical and inorganic chemistry, analytical chemistry, spectrochemistry, radiochemistry and structural chemistry. (J.R.D)

9047 (ORNL-P-718) ORNL DECONTAMINATION RESEARCH TO BE DISCUSSED AT THE VALLECITOS MEETING OF DECEMBER 3 AND 4, 1964. A. B. Meservey (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 27p. (CONF-641203-1).

From Reactor Decontamination Information Exchange Group Meeting, Vallecitos, Calif. Dep.(mn); $2.00(cy), 1(mn) OTS.

Studies on the decontamination of metal surfaces which have been exposed to the coolant in gas-cooled reactors, are described. The materials covered include Zircaloy-2, carbon steel, and stainless steel. (D.L.C.)

9048 (SC-DC-64-380) POLYMER MOLECULAR WEIGHT DETERMINATION BY HIGH-TEMPERATURE VAPOR PRESSURE OSMOMETRY. J. P. Burger (Sandia Lab., Albuquerque, N. Mex.). Mar. 1964. Contract AT(29-1)-789. 22p. (CONF-546-3).

From Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Mar. 1964. Dep.(mn); $1.00(cy), 1(mn) OTS.

Number average molecular weight measurements of polymers have been successfully made by high temperature vapor pressure osmometry employing high boiling solvents. The process of molecular weight determination is separated into calibration and measurements of unknowns. The calibration was carried out in a closed, thermostatically controlled chamber using a nonaqueous probe. This thermoelectric system is based upon the elevation of temperature caused by condensation of dimethylformamide (D.M.F.) vapor in a solution of recrystallized glyceryl tristearate in repurified dimethylformamide. The rate at which the D.M.F. condenses into the solution and, consequently, the temperature elevation, are both dependent upon the molar concentration of the solution. This difference in thermistor resistance (ΔR) is measured by means of a d-c resistance bridge. The ΔR values obtained are divided by the molar concentration. These data are then plotted and extrapolated to zero concentration. The intercept is the calibration factor K in units of ohms liters/mole. The determination of molecular weights of unknown materials is carried out in a manner similar to calibration. (auth)

9049 (NP-tr-1198) THE PRODUCTION AND INVESTIGATION OF TITANIUM–TRITIUM TARGETS. Hans Fabian. Translated by E. J. B. Doggett (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.), from Oesterr. Akad. Wiss., Math.-Naturw. Kl., Anz., No. 570a, 1964. 35p. Dep.(mn); $3.60(fs), $1.25(mf) JCL.

The techniques of target production are described. The tritium losses during storage and the resistance to heat of the titanium–tritium targets are investigated. Measurements of the neutron yield as a function of time showed that the yield expected in theory is in fact obtained initially but that, due to the very considerable loss of tritium, it quickly drops almost to half of the original amount. The causes for the loss of tritium during bombardment in the accelerator are: degassing of the surface, deuterium self-target effect, and sputtering of the titanium layer. It was found possible to increase the lifetime of the targets by a factor of up to three by covering the surface of the titanium with a protective layer. (auth)

9050 CHEMISTRY AND NUCLEAR ENERGY. J. Guéron (Euratom, Brussels). Atomwirtschaft, 9: 604-6 (Dec. 1964). (In German)

A close connection exists between chemistry and nuclear energy in various fields. Classical radiochemistry created order in the classification of the elements, classical nuclear physics showed why certain elements possessed no stable isotopes and the study of fission products led to the completion of the family of rare earths and yielded a wealth of isotopes with surplus neutrons. Nuclear energy development compelled chemistry in particular to develop ultramicrochemical processes and to further develop them for the mass production of new artificially produced elements or isotopes. Nuclear technology forced chemistry to solve new material problems and has the chemist to thank for the availability of materials with the highest purity and with special properties, such, for example, as Hf-free Zr, graphite with minimal B content, etc. While it does not seem possible to predict what new discoveries chemistry can and will make in the field of pure research with the help of the new processes which nuclear technology has made available to it through radioactive substances and radiations and with the help of new instrumentation, it is easy to enumerate those problems in applied research and industry for which a solution is desired: 1. Materials must be still further improved, 2. Manufacturing processes which are less energy consuming must be found for the industrial production of stable or long-lived isotopes, 3. A profitable use must be found for the by-products of nuclear energy, particularly reactor radiation and used nuclear fuels and also the fission products in the form of end substances which are no longer radioactive, 4. The irradiated nuclear fuels have to be reprocessed economically and the still remaining waste materials have to be stored safely. (auth)

Analytical Procedures

Refer also to abstracts 9348, 9405, and 10568.

9051 (AED-C-14-1) AKTIVIERUNGSANALYSE. REIHE C: AUSGEWAHLTES SCHRIFTTUM NACH SACHGEBIETEN. (Activation Analysis. Series C: Selected Reference According to Subject). W. Bock-Werthmann and W. Schulze, comps. (Hahn-Meitner-Institut für Kernforschung, Berlin). May 15, 1961. 280p. Dep.(mn).

Approximately 865 references are presented, arranged according to reports, conference papers, journal articles, books, patents, dissertations, company publications, and nuclide charts. Report and patent, organization, author, and subject indexes are included. (D.L.C.)

9052 (AED-C-14-02) AKTIVIERUNGSANALYSE. REIHE C: AUSGEWAHLTES SCHRIFTTUM NACH SACHGEBIETEN. (Activation Analysis. Series C: Selected Reference According to Subject). W. Bock-Werthmann, comp. (Hahn-Meitner-Institut für Kernforschung, Berlin). May 15, 1962. 226p. Dep.(mn).

A total of 639 references is presented, arranged according to reports, conference papers, journal articles, books, dissertations, patents, and industrial publications. Report, patent, conference, organization, author, and subject indexes are included. (D.L.C.)

9053 (AERE-R-4498) MONITORING LIQUID STREAMS FOR PLUTONIUM IN THE PRESENCE OF AMERICIUM. G. F. Snelling (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1964. 24p. Dep.; $0.70(BIS); 3s. 6d.(HMSO).

In chemical plant streams containing dissolved fuel elements of high burnup, existing alpha counting monitors for measuring plutonium may sometimes be inapplicable due to interference from americium-241. In such instances a monitor able to discriminate between plutonium and americium is required. Information is presented on which the design of such a monitor might be based. (auth)

9054 (AERE-R-4814) RAPID METHODS FOR DETERMINING THE RELATIVE AMOUNTS OF ZIRCONIUM^{95} AND NIOBIUM^{95} BASED ON ANION-EXCHANGE PAPER CHROMATOGRAPHY AND GAMMA-SPECTROMETRY. C. J. Hardy and C. E. Lyon (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1964. 11p. Dep.; $0.30(BIS); 1s. 9d.(HMSO).

The γ activities of ^{95}Zr and ^{95}Nb relative to each other can be obtained rapidly by (a) separation of the two radionuclides by anion exchange paper chromatography in a HCl−HF medium followed by γ-counting sections of the paper (γ spectrometry is necessary if other γ-emitting nuclides are present), and (b) measuring the mean γ energy, or width, of the composite γ photopeak at about 760 kev with a multi-channel γ spectrometer. The chromatographic method is an improvement on previous chromatographic and standard radiochemical methods for these radionuclides and is applicable to their solutions in various mineral acids and organic solvents. The composite γ photopeak method is more rapid but less accurate than the chromatographic method, particularly at low percentages of ^{95}Nb. (auth)

9055 (APDA-164) DETERMINATION OF CARBON IN SODIUM BY A HIGH-TEMPERATURE COMBUSTION METHOD UTILIZING GAS CHROMATOGRAPHY. H. Bradley and S. A. Meacham (Atomic Power Development Associates, Inc., Detroit). Nov. 25, 1964. Contract AT(11-1)-865. 34p. Dep.(mn); $2.00(cy), 1(mn) OTS.

An analytical method for the determination of total carbon in sodium metal is described. The method is based on a stepwise conversion of the total carbon in the sodium sample to sodium carbonate followed by thermal decomposition of the sodium carbonate to carbon dioxide. The carbon dioxide is collected at liquid nitrogen temperature and subsequently measured by gas chromatography. A sample of sodium metal is placed in a quartz combustion system and heated to 1100°C within 1 hour. The residence time at maximum temperature is an additional hour to ensure complete reaction. An atmosphere of approximately 10 : 75 ml/min of oxygen in helium is used during the heating process. The sample is protected from atmospheric contamination by loading the combustion tube in a glove box filled with dry, oxygen-free argon. The method has been in daily use in the APDA laboratory for approximately eight months. During this period, numerous refinements have been made to the original procedure. A representative series of replicate sodium samples analyzed by this method had a standard deviation, s, of ±3 ppm and a relative standard deviation of 8.1%. These results indicate that this method is applicable to the determination of carbon in sodium in the concentration range of 10 to 150 ppm in 0.2- to 0.4-g samples of sodium. The proposed method is capable of giving reasonably precise results with the relative error estimated as being in the range of ±5 to 10%. (auth)

9056 (CEA-R-2542) DETERMINATION NON DESTRUCTIVE DU TAUX DE COMBUSTION D'UN COMBUSTIBLE NUCLEAIRE PAR SPECTROMETRIE γ. (Nondestructive Determination of the Burnup of a Nuclear Fuel Using γ Spectrometry). Charles Engelmann and Jean-Francois Petit (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). Aug. 1964. 35p. Dep.(mn).

A non-destructive method has been developed for measuring the burnup of a nuclear fuel. The principle of the method is based on the quantitative determination of a fission product using γ spectrometry. For fuel elements containing uranium-235, the measurements concern the photoelectric peak at 2.18 Mev of ^{144}Ce which has a half-life of 290 days. The same method could be applied (under certain conditions) to: the measurement of the number of fissions due to ^{239}Pu, by determining the ^{106}Rh, deriving from the ^{106}Ru and having a half-life of 370 days; and (possibly) the non-destructive determination of the quantity of ^{239}Pu present in a fuel element. If the operational program of the reactor is known as a function of time, the possible field of application of the method can be extended to times of irradiation of two to three years. (auth)

9057 (CEA-R-2559) EMPLOI DE PARTICULES AUTRES QUE LES NEUTRONS EN ANALYSE PAR ACTIVATION. (Use of Particles Other Than Neutrons in Activation Analysis). Charles Engelmann (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). July 1964. 87p. Dep.(mn).

Thesis submitted to Conservatoire National des arts et Métiers, Paris.

Nuclear reactions obtained by irradiation in γ bremsstrahlung, α particles, and protons are particularly suitable for dosing very small traces of light elements. The possibilities presented by activation in γ radiation of 28 Mev maximum energy are considered, mainly for the measurement of C, F, N, O, P, and S. Non-destructive methods of analysis for beryllium are described. Under certain conditions they may also be used for other elements such as B, Ca, Li, and Na. Results are given of experiments carried out in an attempt to find a method for dosing carbon and oxygen by irradiation in α particles and protons. For each type of activation, the possible interference of other nuclear reactions is considered. (auth)

9058 (EUR-2156.e) QUANTITATIVE MICROPROBE ANALYSIS. D. Quataert and R. Theisen (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 26p. (CONF-407-10). Dep.(mn).

From Electro Chemical Society, Toronto, May 1964.

On the basis of the calculations published by R. Castaing in his thesis, correction formulas were set up for local microprobe analysis. These formulas concur well with experimental f (χ) curves obtained by Castaing. In addition, an outline is given of the various methods which can be used to allow for atomic number effects. (auth)

9059 (HW-84251) IN-LINE PLUTONIUM ANALYSIS BY USE OF ALPHA SCINTILLATING GLASS AND X-RAY SCINTILLATION TECHNIQUES. C. E. Huck and J. D. Lodge (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 14, 1964. Contract AT(45-1)-1350. 23p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The low level detection of plutonium by use of either alpha scintillating glass or x-ray scintillation techniques was effectively demonstrated in both laboratory and in-line plant tests. Nitric acid resistance and short term decontamination performance of both the Corning type 7913 scintillating glass and the x-ray Tenite protective disk have also been demonstrated. The x-ray monitor is usable for ^{241}Am analysis by centering the differential analyzer window on the characteristic 60-kev ^{241}Am energy peak. Both the alpha and the x-ray monitors have linear response with plutonium concentration from 0.0001 g/l Pu up to the tested maximum of about 1 g/l Pu. (auth)

9060 (IDO-14649) BURNUP DETERMINATION OF NUCLEAR FUELS: 1963 ANNUAL PROGRESS REPORT. J. E. Rein and W. J. Maeck, eds. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 1964. Contract AT(10-1)-205. 27p. Dep.; $2.00(OTS)

A description is given of the status of the project to develop methods for the determination of burnup of nuclear fuels. The emphasis is on high burnup fuels. The major analytical technique being investigated is stable fission product analysis. (auth)

9061 (LA-3160) THE X-RAY FLUORESCENCE SPECTROMETRIC DETERMINATION OF MANGANESE IN URANIUM–PLUTONIUM–MANGANESE ALLOYS. E. A. Hakkila, R. G. Hurley, and G. R. Waterbury (Los Alamos Scientific Lab., N. Mex.). Sept. 1, 1964. Contract W-7405-eng-36. 16p. Dep.; $1.00(OTS)

Manganese in uranium–plutonium–manganese alloys is determined without chemical separation using an internal standard x-ray fluorescence spectrographic method. The ternary alloy is dissolved in nitric acid, iron is added to serve as the internal standard, and the solution is irradiated using a tungsten-target x-ray tube. The ratios of the intensities of the Kα x-ray lines for iron and manganese are measured and compared to ratios measured for solutions of known manganese content. The method is applicable to the determination of 5 to 40% of manganese in the presence of 5 to 50% each of plutonium and uranium with a relative standard deviation in the range between 2 and 0.8%. Because of selective absorption by the M I edge for plutonium, separate calibration curves must be prepared in the presence of greater than 50% of plutonium. (auth)

9062 (LF-18) ULTRAMICRO METHODS IN BIOCHEMISTRY. III. THE DETERMINATION OF SERUM CHOLESTEROL. IV. THE DETERMINATION OF GLUCOSE. E. V. Stewart and B. B. Longwell (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Oct. 1964. Contract AT(29-2)-1013. 28p. Dep. ; $0.50(OTS)

Ultramicro procedures for the determination of serum cholesterol and of serum, plasma, or whole-blood glucose are described. (C.H.)

9063 (ORNL-3744) DETERMINATION OF NUCLIDE CONCENTRATIONS IN SOLUTIONS CONTAINING LOW LEVELS OF RADIOACTIVITY BY LEAST-SQUARES RESOLUTION OF THE GAMMA-RAY SPECTRA. E. Schonfeld, A. H. Kibbey, and W. Davis, Jr. (Oak Ridge National Lab., Tenn.). Jan. 1965. Contract W-7405-eng-26. 59p. Dep.; $3.00(OTS)

One of the most difficult and expensive analyses associated with radioactive-waste disposal is the determination of the amount of each of four to ten radioactive nuclides when present only at the very low radioactivity levels of 10^2 to 10^5 $\mu\mu$C per liter. Gamma-ray spectrum resolution, previously developed to determine higher specific activities, based on data analysis by high speed computer, was tested and found to provide a rapid, semiautomatic, reasonably accurate method for these analyses at a cost of 5 to 25 times less than that for conventional methods. The savings increase with the number of samples. Tests, with two multichannel spectrometers, and data analyses by the method of least squares, using a high speed computer, were made with solutions of ^{60}Co, ^{85}Sr, ^{141}Ce, and ^{144}Ce added as tracers to water containing ^{90}Sr, ^{95}Zr–Nb, ^{106}Ru, ^{134}Cs, and ^{137}Cs. The lowest concentration of radioactivity was about one-tenth of the lowest value previously determined by this technique, that is, down to 10 counts/min. Evaporation by factors up to 20 was also evaluated for improving accuracies of analyses. For comparison, the solutions were also analyzed by standard radiochemical methods. Agreement between the two methods was excellent for ^{60}Co and ^{85}Sr for concentrations down to about 500 $\mu\mu$C/liter (scatter of ±5 to ±20%). Agreement between the two methods was good for ^{137}Cs at activities down to 3000 to 4000 $\mu\mu$C/liter; comparative values from the two methods differed by factors of 5 to 10 for ^{144}Ce except at activities above 1600 $\mu\mu$C/liter. More dilute solutions were successfully analyzed only if they were first concentrated by evaporation. The method is not recommended for determination of ^{106}Ru at activities below 1000 to 2000 $\mu\mu$C/liter, unless this nuclide constitutes a major fraction of the total activity and ^{85}Sr is a minor component. Several contributions to the mathematical techniques of gamma-ray spectrum resolution are reported. These include: data showing that gain shifts up to 5%, and threshold shifts of two channels, can be accurately handled by a computer program; resolution of the errors of concentration estimates into contributions by background and the various radioactive species present; and use of chi-square to test the overall reliability of the multichannel spectrometer. (auth)

9064 (CEA-tr-X-585) ANALYSE DES SUBSTANCES MINERALES PAR RADIOACTIVATION SUR PAPIER CHROMATOGRAPHIQUE. (Analysis of Inorganic Substances by Radioactivation on Chromatographic Paper). T. Nascutiu. Translated into French from Acad. Rep. Populare Romine, Studii Cercetari Chim., 10: 275-84 (1962). 23p. Dep.(mn); $2.60(fs), $0.89(mf) JCL.

The possibility of combining radioactivation analysis with paper chromatography for the analysis of mineral substances was investigated. To determine the reproducibility of the analysis, different quantities of solutions of Re, uranyl nitrate, sodium nitrate, telluric acid, and lanthanum oxide dissolved in HNO_3 were deposited on chromatographic paper, and the papers were irradiated. The results show the possibility of the quantitative determination of inorganic substance separated by paper chromatography and irradiated with thermal neutrons. The great sensitivity of the method, the possibility of an easy separation of mixtures containing very varied elements, a relatively short analysis time, and the precision of the method for small quantities of the substance are some of the advantages. One disadvantage is the difficulty of determining elements present in only very low percentages. (J.S.R.)

9065 (FTD-MT-64-64(p.69-74) ON THE POSSIBILITY OF SPECTRAL-ISOTOPIC DETECTION OF OXYGEN IN METALS. A. N. Zaydel', G. S. Lazeev (Lazeyev), and A. A. Petrov. Translated from Vestn. Leningr. Univ., Ser. Fiz. i Khim., No. 1, 1963.

The method is shown to be applicable to oxygen detection in iron and cobalt powders. Isotopic equilibrium conditions are found, and "correction of idle experiment" is determined. Preliminarily, a method of spectroscopic detection of oxygen isotopes from spectra of CO molecule is worked out. (auth)

9066 (NP-tr-1199) DETERMINATION OF INORGANIC ANIONS VIA EDTA TITRATIONS. A Review. A. J. Barnard, Jr., and W. C. Broad (Baker (J. T.) Chemical Co., Phillipsburg, N. J.). Translated from Rev. Univ. Ind. Santander, 6: 70-8(1964). 14p. Dep.(mn); Free(J. T. Baker Chemical Co., Phillipsburg, N. J.).

The application of the EDTA titration method to the determination of an inorganic anion involves its reaction with a polyvalent metal ion which is subsequently determined by an EDTA titration. This indirect determination of some 34 inorganic anions is reviewed, with emphasis on the phosphate, sulfate, and halides. Other radical anions such as molybdate, niobate, rhenate, etc., are also covered. (D.L.C.)

9067 COMPLEXOMETRIC TITRATIONS WITH RADIOMETRIC END POINT DETECTION. DETERMINATIONS BY INDIRECT AND BACK TITRATIONS. T. Braun (Eötvös Univ., Budapest). Acta Chim. Acad. Sci. Hung., 41: 199-207(1964).

The radiocomplexometric method of titration previously evolved was applied to indirect and back titrations. In the indirect titrations, the component to be determined was separated as a precipitate whose other component, on dissolving the precipitate, can directly be titrated with EDTA. As model substances, tungstate and sodium ions were determined. In both cases solid $^{110}AgIO_3$ served as indicator. The radiocomplexometric back titration of aluminum with a solution of calcium nitrate as titrant can similarly be carried out by indication with $^{110}AgIO_3$. (auth)

9068 AMPEROMETRIC TITRATION OF URANIUM(IV) WITH IRON(III). R. F. Sympson, R. P. Larsen, R. J. Meyer, and R. D. Oldham (Argonne National Lab., Ill.). Anal. Chem., 37: 58-60(Jan. 1965).

A method was developed for the precise oxidimetric titration of uranium with iron(III) in which the end points are detected amperometrically with a rotating platinum electrode. After reducing the uranium to a mixture of the (III) and (IV) oxidation states with zinc the titration is carried out, first to the uranium(III)–(IV) end point and then to the uranium(IV)–(VI) end point. For samples containing 200 and 20 mg of uranium, precisions of 0.1 and 0.3% relative standard deviation are obtainable with no significant bias. (auth)

9069 SIMULTANEOUS DETERMINATION OF OXYGEN AND NITROGEN IN REFRACTORY METALS BY THE DIRECT CURRENT CARBON-ARC, GAS CHROMATOGRAPHIC TECHNIQUE. Royce K. Winge and Velmer A. Fassel (Iowa State Univ., Ames). Anal. Chem., 37: 67-70(Jan. 1965). (IS-970)

The d-c carbon-arc, gas chromatographic technique was applied to the simultaneous determination of the oxygen and nitrogen content of refractory metals. With the aid of a platinum flux, the oxygen and nitrogen are liberated from the metal as carbon monoxide and molecular nitrogen into a static helium atmosphere. An aliquot of the resulting gas mixture is then passed through a gas chromatograph and the respective peak heights are related to the oxygen and nitrogen contents in the metal. Analytical data obtained from 12 different base metals suggested that single oxygen and nitrogen analytical curves can be used for determining these impurities in most refractory metals and alloys. (auth)

9070 SPECTROPHOTOMETRIC DETERMINATION OF THE LANTHANIDES AS EXTRACTED NITRATE COMPLEXES. William J. Maeck, Maxine E. Kussy, and James E. Rein (Phillips Petroleum Co., Idaho Falls, Idaho). Anal. Chem., 37: 103-6(Jan. 1965).

In the absence of strong salvation, ion association complexation of the lanthanide ions is promoted, which disturbs internal 4f electron transitions to cause wavelength shifts and intensity changes of the corresponding absorption bands. Such a condition is obtained by an extraction of the lanthanides from an aluminum nitrate salted aqueous phase into an organic medium that contains tetrabutylammonium nitrate. One absorption band in the visible region for each of four lanthanides, neodymium, samarium, holmium, and erbium, is markedly enhanced to form the basis for a spectrophotometric method. The fact that the enhanced peaks are well separated provides for the simultaneous determination of these four lanthanides. The tolerance to diverse cations including other lanthanides and to inorganic anions is high. (auth)

9071 EXPERIMENTAL REACTOR THERMAL-NEUTRON ACTIVATION ANALYSIS SENSITIVITIES. Herbert P. Yule (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Anal. Chem., 37: 129-32(Jan. 1965). (GA-5631)

Gamma photopeak yields were experimentally determined for 118 reactor thermal-neutron products of all elements from oxygen through lead (except Ne, Kr, and Xe). Limits of detection (sensitivities) were estimated from these data; the median sensitivity was about 10^{-3} ppm for a 10-gram sample. The use of reactor thermal neutrons for these measurements has several advantages. Because the yield data are experimentally determined, they are not subject to inaccuracies found in theoretical estimates caused by poorly known nuclear parameters. The high thermal-neutron flux available in the reactor made possible the observation of a number of additional activation products not included in previously published lists containing experimentally determined thermal-neutron product yields. These additional products offer alternative means of analysis, which may be useful in circumventing matrix activation problems. The present list contains data on essentially all important thermal-neutron products for those elements amenable to neutron activation analysis utilizing gamma counting. (auth)

9072 LIQUID SCINTILLATION COUNTING OF H^3-NUCLEIC ACIDS. Toshie Hattori (Tokyo Univ.), Hiroko Aoki, Itsuko Matsuzaki, Bunji Maruo, and Hajime Takahashi. Anal. Chem., 37: 159-61(Jan. 1965).

A liquid scintillation method, which employed digestion of the nucleic acid samples by HCl prior to the addition of hyamine-dioxane solvent system, appeared to be a convenient method for routine radioassay of nucleic acids. Data obtained by this method are presented in tables and graphs. (M.C.G.)

9073 DETERMINATION OF LANTHANUM IN ACTINIDE-LANTHANIDE MIXTURES BY ISOTOPIC DILUTION AND MASS SPECTROMETRY. W. B. Hess (E. I. du Pont de Nemours & Co., Aiken, S. C.) and H. P. Holcomb. Anal. Chem., 37: 169-70(Jan. 1965). (TID-21049)

Isotopic dilution and mass spectrometry were used to determine lanthanum in highly radioactive solutions of americium, curium, and rare earths. A relative standard deviation of ±1.9% was obtained for analysis of a process sample containing 27.1 g/l of lanthanum. (M.C.G.)

9074 ISOTOPE DILUTION ANALYSES BY SPARK SOURCE MASS SPECTROGRAPHY. Fredric D. Leipziger (Sperry Rand Research Center, Sudbury, Mass.). Anal. Chem., 37: 171-2(Jan. 1965).

The capability of the spark source mass spectrograph for ionization of all elements made it possible to analyze several materials for trace amounts of copper and antimony by stable isotope dilution. ^{65}Cu and ^{123}Sb were used as tracers. A standard deviation of 5% was obtained. (M.C.G.)

9075 THE USE OF NON-DESTRUCTIVE ACTIVATION ANALYSIS FOR THE ESTIMATION OF SODIUM IN BIOLOGIC MATERIAL. M. Rakovič and H. Talpová (Charles Univ., Prague). Casopis Lekaru Ceskych, 103: 632-5 (1964).

An extremely sensitive method for the estimation of sodium in biological material by means of neutron activation analysis is described. The sample is activated by a flux of neutrons, $1.5 \cdot 10^{12}$ of neutrons/sq.cm. sec. for 20 hrs. A few hundredths or tenths of milligram of dry weight of the sample are sufficient for the analysis. If necessary the order of sensitivity may be increased by the use of a higher flux of neutrons. The method may yield somewhat higher results, particularly with the use of material containing much higher quantities of potassium than of sodium. For this instance, a formula is given by which the measured results may be corrected. (Excerpta Med., Sect. XXIII, 1: Nov. 1964)

9076 MÖSSBAUER ANALYSIS OF IRON IN STONE METEORITES. E. L. Sprenkel-Segel and S. S. Hanna (Argonne National Lab., Ill.). Geochim. Cosmochim. Acta, 28: 1913-31(Dec. 1964).

The absorption of resonant gamma rays by ^{57}Fe nuclei in stone meteorites produced patterns characteristic of the various iron compounds in the meteorite. By comparison with absorption patterns of terrestial reference minerals, the meteoritic compounds may be identified and the relative amounts of iron in each mineral determined. The minerals identified in the Plainview meteorite were olivine and pyroxene (ferromagnesian silicates), troilite (a sulfide), and kamacite (an iron-nickel alloy). The absorption patterns of the Holbrook and Johnstown meteorites were also investigated. (auth)

9077 THE EVALUATION OF A RAPID SOLVENT EXTRACTION METHOD FOR THE DETERMINATION OF STRONTIUM-90 IN MILK. E. R. Mercer, J. D. Burton, K. B. Gunn, and A. Black (Agricultural Research Council Radiobiological Lab., Wantage, Berks, Eng.). Health Phys., 11: 37-40(Jan. 1965).

A procedure for measuring strontium-90, which depends on the solvent extraction of yttrium-90, was compared with the more widely used method of strontium purification, for the analysis of milk in environmental surveys. A comparison of measurements on eighty-six samples showed that the results obtained by the two methods agree closely; both procedures are of similar precision. The solvent extraction method has advantages of speed and simplicity, though it is subject to limitations for samples containing other rare earth activities. (auth)

9078 DECREASED RECOVERY OF GROSS ALPHA DETERMINATIONS BY ALKALINE PHOSPHATE PRECIPITATION IN THE PRESENCE OF DTPA. Anne de G. Low-Beer and Howard G. Parker (Univ. of California, Berkeley). Health Phys., 11: 61-2(Jan. 1965).

Studies were made to determine whether gross alpha activity determination in the presence of diethylenetriaminepentaacetic acid (DTPA) would be equally effective as alkaline phosphate precipitation. The recovery of ^{241}Am was investigated in the presence of DTPA by the alkaline phosphate precipitation method. Results with the wet ashing method were compared for spikes processed in aqueous solution, for human urine spiked in vitro, and for urine of rats injected with ^{241}Am and DTPA. Recovery rates by the two methods were also compared when DTPA was not present. The results showed that in water or urine, recovery of ^{241}Am from the alkaline phosphate precipitate was only slightly less than for the wet ash method. In the presence of DTPA, recovery in the precipitate was approximately 10%. It was concluded that at pH 8 ^{241}Am is strongly chelated, and accordingly the alkaline phosphate precipitation method is not suitable for the quantitation of urinary activity in patients who have been treated with DTPA. (P.C.H.)

9079 COMPOSITIONAL ANALYSIS OF TWENTY-SIX ZIRCONIAS. R. E. Heffelfinger, E. R. Blosser, and W. M. Henry (Battelle Memorial Inst., Columbus, Ohio). J. Am. Ceram. Soc., 47: 646-8(Dec. 21, 1964).

Twenty-six zirconia samples were analyzed for metallic impurities, which could be determined by emission spectrography. Sulfur contents were determined chemically. Six of the materials were also analyzed by mass spectrography to determine, to a very low concentration level, the presence or absence of nearly every element in the periodic table. The results are presented in tables. (M.C.G.)

9080 CHEMICAL DETERMINATION OF RADIUM IN SEAWATER. Yukio Sugimura and Hiroyuki Tsubota (Meteorological Research Inst., Tokyo). J. Marine Res. (Sears Found. Marine Res.), 21: No. 2, 74-80(1963).

For determination of Ra in sea water, precipitate $CaCO_3$ from 1 liter of sea water (previously adjusted to pH 7) with ammonium carbonate. Dissolve the precipitate in HCl, and add Ba carrier. Adjust the pH to 4 with acetate buffer solution, and add 25 ml of 0.2% Na rhodizonate solution in a phthalate buffer at pH 7. After 15 min, adjust the pH to 1 by slow addition of dilute HCl. Dissolve the precipitate (Ba plus Ra) in hot 4N HNO_3, evaporate the solution to dryness, and dissolve the residue in 0.4N HNO_3. Adsorb the metals on a column (20 cm × 0.6 cm) of a strong cation exchanger (H^+ form; 100 to 200 mesh). Wash the column with 50 ml of H_2O and elute with ammonium formate solution. Discard the first 60 ml (Ba fraction) of eluate; evaporate the next 60 ml to dryness, and dissolve the ignited residue in 5 ml of formic acid and ammonium formate. Evaporate the solution on a platinum disc, and ignite the residue. Determine ^{226}Ra by means of the 4.777-Mev peak. (Anal. Abstr., 11: No. 11 (Nov. 1964))

9081 THE DETERMINATION OF TRACES OF PALLADIUM AND PLATINUM IN SULPHIDE MINERALS BY NEUTRON-ACTIVATION ANALYSIS. Donald F. C. Morris, Norman Hill, and Barbara A. Smith (Brunel Coll., London). Mikrochim. Ichnoanal. Acta, No. 5-6, 962-9 (1963).

A neutron activation method is described for determination of small concentrations of palladium and platinum in sulfide minerals. The method is a comparative one involving irradiation of samples and standards in a nuclear reactor. Radiochemical separations using carriers are employed to isolate the induced palladium and platinum activities. (auth)

9082 ACTIVATION ANALYSIS DETERMINATION OF IMPURITIES IN ALUMINUM. III. DETERMINATION OF IRON, COBALT, ZINC, AND SCANDIUM. W. Kiesl, H. Sorantin, and V. Pfeifer (Österreichische Studiengesellschaft für Atomenergie GmbH, Vienna and Universität, Vienna). Mikrochim. Ichnoanal. Acta, No. 5-6, 996-1002(1963). (In German)

The activation analytical determination of the elements iron, cobalt, zinc, and scandium in aluminum is described. These metals are separated from each other by a solvent extraction procedure in the following order: iron in 8N HCl with diisopropyl ether, cobalt at pH 3 to 4 with 2-nitroso-1-naphthol, and chloroform, zinc in 2N HCl with TBP (100%), and scandium in 8N HCl with TBP (100%). (auth)

9083 SEMIQUANTITATIVE ISOTOPE DILUTION ANALYSIS IN MICRO- AND SUBMICROGRAM REGIONS WITH THE HELP OF THE RING OVEN METHOD. H. Weisz and D. Klockow (Universität, Freiburg i. B.). Mikrochim. Ichnoanal. Acta, No. 5-6, 1082-93(1963). (In German)

A semiquantitative analytical procedure is described, which essentially is a combination of isotope dilution analysis with ring oven techniques. To the test solution of an ion (x μg) there was added a constant amount (a μg) of the same ion in radioactive form. A portion (b μg) of x + a is precipitated with a suitable precipitant and collected on a circular filter with the aid of the ring oven method. The counter rates corresponding to the portion b and x + a – b are determined. The evaluation of data is made by a graphic method with the aid of a standard curve. The method is discussed using as an example the determination of Ca^{2+}, PO_4^{3-}, and Fe^{3+}. Amounts ranging from several micrograms of these ions can be determined with adequate accuracy. (auth)

9084 A METHOD FOR TRACE ANALYSIS OF TITANIUM AND VANADIUM IN GRAPHITIC MATERIALS. E. Schroll, I. Janda, I. Schausberger, and H. Spatzek (Bundesversuchs- und Forschungsanstalt Arsenal, Vienna). Mikrochim. Ichnoanal. Acta, No. 5-6, 1126-31(1963). (In German)

A trace analytical method was worked out for determining titanium and vanadium in reactor graphites. It permits determination of these elements down to 0.1 ppm with the aid of the double arc method and with the use of $PbCl_2$ as a thermochemical additive. (auth)

9085 THE RADIOMETRICAL DETERMINATION OF PHOSPHATE IONS IN RADIOPHOSPHATE SOLUTIONS WITH CARRIER. R. Vasiliev. Pharmazie, 18: 801-2(Dec. 1963). (In German)

The use of radioactive phosphate solutions for diagnostic or therapeutic purposes requires an accurate control of both the total phosphate and the active phosphate in solution. The determination of the total phosphate can be carried out photometrically by using a Mo reagent. The determination of radiophosphate in $Na_2{}^{32}PO_4$ solution was carried out radiometrically by using ^{45}Ca- or ^{60}Co-containing reagents, but neither method was satisfactory. For this reason, a new method was worked out based on the use of ^{32}P as the indicator and a suitable precipitating reagent for the $^{32}PO_4^{3-}$-ion so that 2 points can be fixed on the radiometric titration curve from which the specific activity as well as the amount of inactive carrier can be determined. As a suitable titrating reagent a well-defined nitric acid solution of $Bi(NO_3)_3$ was used. The test solution was diluted to 150 μg Na_2PO_4/ml and 0.5 ml of this solution was poured into a centrifugal vessel, precipitated with 0.01 M $Bi(NO_3)_3$ solution, and the activity of the solution determined before and after precipitation and centrifugation. From the data obtained with a NaI(Tl) well scintillation counter, the specific activity and the total phosphate content could be calculated with a sufficiently high degree of accuracy. (OID)

9086 A STUDY OF DETECTING ARTIFICIAL RADIOACTIVE ISOTOPES Cu^{66}, Al^{28} AND Mn^{56} IN THE BOREHOLES BY A RADIOACTIVATED METHOD. Yu-chun Chang and Shou-tien Lee. Ti Ch'iu Wu Li Hsueh Pao, 12: 179-91(1963).

Studies were made on the detection of the short-living isotope ^{66}Cu in boreholes instead of the long-living one ^{64}Cu for qualitative determination of copper content in copper deposits. However, the half live period and the gamma spectra of the main desired artificial isotopes of the chemical samples and of rocks in skarn type copper deposits boreholes were measured by the activation of Po–Be neutron source (5-12 × 10^6 n/sec). Experiments show that, under field conditions, to detect ^{64}Cu is practicable. Good results of detecting ^{28}Al and ^{56}Mn were also obtained. It is presumed that the artificial radioactive isotopes ^{28}Al and ^{56}Mn are applicable in prospecting for aluminium and manganese deposits. The method is further suggested to be feasible for the prospecting of rare metals (e.g. V, In etc.). It is expected to raise the technical level of the measuring apparatus, to perfect the method for reliable and simple interpretation and analysis of the measuring results, and improve the safety operation. (TCO)

9087 RARE EARTH LUMINESCENCE AND ITS APPLICATIONS IN ANALYTICAL CHEMISTRY. L. I. Anikina and A. V. Karyakin. (V. I. Vernadskii Inst. of Geochemistry and Analytical Chemistry at the USSR Academy of Sciences) Usp. Khim., 33: 1337-48(Nov. 1964). (In Russian)

Luminescence analysis was made of rare earths, rare earth compounds, and rare earth-activated phosphor crystals. Applications of rare earth luminescence in analytical chemistry are surveyed. (125 references). (R.V.J.)

9088 DETERMINATION OF COLORED ^{14}C-NITROCOMPOUNDS USING LIQUID SCINTILLATION COUNTER. Yuzo Nagase, Shigeo Baba, and Tatsuo Ido (Tokyo Coll. of Pharmacy). Yakugaku Zasshi, 84: 202-5(Feb. 1964). (In Japanese)

Tests were conducted on the measurement of radioactivity using a liquid scintillation counter by removal of the effect of quenching action of colored nitro compounds. In this method, the sample is electrolytically reduced directly in the vessel used for the measurement. A hydrophilic scintillator is added and measured at an applied voltage of 1300 v and a discriminator voltage of 10 v to ∞. This method was used on model compounds (2,4-dinitrophenylhydrazine derivatives of propiophenone(1-^{14}C) and 4-methoxybenzophenone (carbonyl-^{14}C)). Measurement could be made with ~90% efficiency. Reproducibility of this method was within statistical error. (BBB)

9089 DETERMINATION OF SMALL QUANTITIES OF CERIUM (REVIEW). Yu. G. Eremin, L. A. Lavrova, V. V. Raevskaya, and P. N. Romanov. Zavodsk. Lab., 30: 1427-33 (1964). (In Russian)

Various methods for determining and separating small quantities of Ce are reviewed. (132 references.) (R.V.J.)

9090 SELECTION OF ELECTROMETRIC METHOD FOR URANIUM DETERMINATION BY VANADATE AND COMPLEXON TITRATION. P. K. Agasyan, E. R. Nikolaeva, and L. A. Demina (Moscow State Univ.). Zavodsk. Lab., 30: 1434-8(1964). (In Russian)

Studies of polarization curves i = f(E) and titration of U(IV) by vanadates and complexon(III) indicated the efficiency of potentiometric and amperometric titration with two polarized electrodes. (tr-auth)

9091 DETERMINATION OF SCANDIUM IN ALUMINOSILICATES, CARBON ASH, AND MINERALS. M. P. Belopol'skii and N. P. Popov (All Union-Scientific-Research Inst. of Geology, USSR). Zavodsk. Lab., 30: 1441-2 (1964). (In Russian)

A colorimetric method of Sc determination following precipitation of scandium–yttrium tartrate is described. The determination was carried out at pH 2 with xylenol orange without preliminary separation of yttrium. (tr-auth)

9092 AN EMANATION SYSTEM FOR DETERMINING SMALL QUANTITIES OF RADIUM-226. Richard L. Blanchard (Public Health Service, Washington, D. C.). Public Health Service Publication No. 999-RH-9. Nov. 1964. 19p. (Free from USPHS)

A detailed account is given of the construction, operation, and characteristics of an emanation system for the determination of radium-226. The method is specific for radium-226, is well suited for large volume samples containing small quantities of this nuclide, and will accommodate any type of sample that can be prepared in an aqueous solution. The limit of detection at the 95-percent confidence level was calculated to be 0.016 picograms of radium-226, and the transfer and collection of radon-222 were determined to be 100 percent with an average deviation of 3 percent. (auth)

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Refer also to abstracts 9530, 10564, 10566, and 10567.

9093 (CEA-R-2463) EFFET DE TEMPERATURE SUR LES BANDES DE VALENCE DE HDO DANS L'EAU A L'ETAT LIQUIDE ET A L'ETAT SOLIDE CONSEQUENCES POUR L'ANALYSE DE L'EAU LOURDE PAR ABSORPTION INFRA-ROUGE. (Effect of Temperature on the Valency Bands of HDO in Water in the Liquid and Solid States. Effects on the Analysis of Heavy Water Using Infrared Absorption). Maurice Ceccaldi (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Aug. 1964. 36p. Dep.(mn).

After a description of the technique used, a qualitative examination is made of the influence of the temperature on the ν_{OH} (3,400 cm^{-1}) and ν_{OD} (2,500 cm^{-1}) valence bands of HDO in the liquid state and then during the passage to the solid state. Quantitative examination with two cells of different thickness makes it possible to define the influence of temperature on the residual absorption of the pure liquid (D_2O or H_2O and on the valency bands (ν_{OH} and ν_{OD} respectively). It is found that a similar change occurs in the two bands but that the changes in the background are very different. During the passage from the liquid to the solid state the shape of the bands varies considerably but little change occurs in the total intensity. It has been possible to express these results in a simple form which is directly applicable to analytical problems. (auth)

9094 (CEA-R-2543) DETERMINATION DE LA CAPACITE D'ECHANGE DES SOLS AU MOYEN DU RADIOSTRONTIUM. (Determination of the Exchange Capacity of Soils Using Radio-Strontium). André Grauby and Arsène Saas (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). Oct. 1964. 11p. Dep. (mn).

In order to improve the technique and in particular to reduce the time required for measuring the exchange capacity of soils, a rapid measurement method was developed based on the use of radioactive tracers. The element chosen for showing the occurence of exchangeable bases is radiostrontium; it can displace the ions Ca^{++}, Mg^{++}, Na^+, K^+ from the soil. The use of a desorbant, barium chloride, makes it possible to recover the strontium fixed. A comparison of the results obtained using the two methods appears to be very satisfactory. The conventional method requires from 1.5 to 2 days, while the radiostrontium method requires only 3 hours with the possibility also of carrying out large series of measurements. (auth)

9095 (JINR-P-1904) ISSLEDOVANIE DINAMIKI MOLEKULYARIYKH GRUPP NH_4^+ I H_2O V KRISTALLAKH. (An Investigation of the Dynamics of Molecular Groups in Crystals). A. Baiorek, T. A. Machekhina, and K. Porlin'ski (Joint Inst. of Nuclear Research, Lab. of Neutron Physics). 1964. 28p. Dep.(mn).

A neutron spectrometer with a filter in front of the detector was used to investigate the dynamics of the ammonium ions and crystallization water in different chemical compounds over a wide range of temperatures. The investigations were carried out to clear up the nature of the phase transitions and the influence of different crystal configurations on the dynamics of the molecular groups. The measurements were made for the following materials: NH_4F, NH_4Cl, NH_4Br, NH_4I, $(NH)_2SO_4$, NH_4CNS, $(NH_4)_2Cr_2O_7$, $(NH_4)_2S_2O_8$, $(NH_4)_2(COO)_2$, $(NH_4)_2CO_3$, H_2O, $BaCl_2 \cdot 2H_2O$, $SrCl_2 \cdot 6H_2O$, $CuSO_4 \cdot 5H_2O$. The neutron spectra for the compounds with the NH_4^+ group and for the crystalline hydrates are rather similar. At low temperatures characteristic peaks can be seen which are due to the torsional oscillators of the molecular groups. It was observed that in the temperature behavior of the elastic part of the spectra some phase transitions are manifested. (auth)

9096 (ORNL-P-403) DIRECT SPECTROPHOTOMETRIC STUDIES OF REDOX REACTIONS IN MOLTEN FLUORIDE SALTS; ELECTROCHEMICAL IMPLICATIONS. J. P. Young (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 21p. (CONF-742-3).

From 15th CITCE Meeting (International Committee on Thermodynamics and Electrochemical Kinetics) London, Sept. 1964. Dep.(mn); $1.00(cy), 1(mn) OTS

A description is given of techniques and equipment which were developed for high-temperature spectrophotometric studies in molten fluoride salts. Results are discussed of studies of reactions in LiF−NaF−KF eutectic, $LiF-BeF_2$, and $LiF-BeF_2-ZrF_4$. The reaction studies in LiF−NaF−KF eutectic includes a number of metals, U, and UF_3. The spectra of K and/or Na, NiF_2, and FeF_2 in LiF−NaF−KF were studied. The spectrum of Li in molten LiCl is also given. (D.L.C.)

9097 (ORNL-P-707) A STUDY OF THE PHASE BEHAVIOR OF THE ALUMINUM TRICHLORIDE−ZIRCONIUM TETRACHLORIDE SYSTEM. Arthur J. Shor (Oak Ridge National Lab., Tenn.). Dec. 1964. Contract [W-7405-eng-26]. 56p. Dep.(mn); $3.00(cy), 1(mn) OTS.

Thesis submitted to Univ. of Tennessee, Knoxville.

The $AlCl_3-ZrCl_4$ binary system was studied through the complete range of compositions using differential thermal and visual analyses of melting and freezing phenomena. The results indicate a monotectic at 192° consisting of an equilibrium of solid $ZrCl_4$ with two liquid solution phases. The narrow liquid-liquid immiscibility region appeared to extend from 4 to 10% $ZrCl_4$. A eutectic at 2 to 3% $ZrCl_4$ was formed at 170° while below this concentration some degree of solution of $ZrCl_4$ in solid $AlCl_3$ may have occurred. No evidence of compound formation was shown by x-ray diffraction analysis. The phase diagram obtained appears to be consistent with trends of data reported in other investigations of binary systems containing aluminum trichloride. The possible use of $AlCl_3-ZrCl_4$ as a Friedel-Crafts catalyst and of $ZrCl_4$ to improve the Pa extraction by $AlCl_3$ was studied briefly. (D.L.C.)

9098 (UCRL-7631-T) THE USE OF RADIOACTIVE TRACERS IN MARKER MOVEMENT EXPERIMENTS. Ralph H. Condit and J. Birch Holt (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 16, 1963. Contract [W-7405-eng-48]. 11p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The use of radioactive tracers as markers in Kirkendall-type experiments is reviewed with particular attention being given to oxidation studies. Whereas the location of a radiotracer is usually determined by measuring its emitted radiation, it is pointed out that radioactive decay is accompanied by a recoil of the daughter product atom, and this makes possible the design of experiments in which the recoil atoms are collected and measured instead. The range of penetration of recoil atoms through solids will usually be less than a few hundred Ångstroms, and their escape from an oxidized surface of a metal may be taken as a sensitive indicator of how deep the tracer was buried during the oxidation. Experimental results using thorium-228 which gives a radium-224 recoil daughter are reported. Indications are that the high temperature oxidation of nickel, beryllium, and probably aluminum proceeds via cation diffusion through the oxide, while the oxidation of silicon is via oxygen diffusion. It appears that zirconium may oxidize by either mechanism depending on circumstances. Magnesium under conditions of linear oxidation is found to oxidize via oxygen diffusion. (auth)

9099 (UCRL-11704) TEMPERATURE DEPENDENCE OF TRANSVERSE RELAXATION TIME OF OXYGEN-17 IN AQUEOUS SOLUTIONS CONTAINING CUPRIC AND CHROMOUS IONS (thesis). Charles Waymond Merideth (California. Univ., Berkeley). Jan. 1965. Contract W-7405-eng-48. 102p. Dep.(mn); $4.00(cy), 2(mn) OTS.

The temperature dependence of the transverse relaxation time, T_2, of oxygen-17 in aqueous solutions containing cupric and chromous ions was studied in the temperature range −59.6 to 150°C. The low-temperature region was rendered accessible by using eutectic solutions of water and perchloric acid (40.7% $HClO_4$ by wt). As a result of this study, lower limits were set for both the rate of exchange of water molecules from the first coordination sphere of the paramagnetic ions and the rate of inversion of the distorted octahedra of water molecules surrounding the metal ions. The enthalpies of activation for these exchange processes are given. The rate constants for the exchange are observed to be larger than those reported for other plus two ions of the iron group. These large rate constants have been interpreted in terms of the Jahn-Teller distortion of the octahedra of water molecules around the hydrated cupric and chromous ions. In the case of the cupric-water system, the observed temperature dependence of T_{2p} for oxygen-17 is seen to parallel that for the T_{2_e} of the paramagnetic electron of the cupric ion. An explanation of this rather striking phenomenon is given by proposing that T_{2_e} relaxation for the paramagnetic electron is a function of the chemical exchange process detected by the nuclear magnetic resonance measurements. The chemical shift of the resonance of the bulk water molecules as a result of the presence of the paramagnetic ions was measured in both cases. This represents the first measurement of the shift for the oxygen-17 nuclear resonance in the presence of cupric ions and was made possible only by observing the system at elevated temperatures. The shift measured for oxygen-17 in the presence of chromous ion is shown to be in good agreement with the value reported in the literature. From these chemical shift measurements the average coupling constants for the interaction of the oxygen-17 nucleus and the paramagnetic ions were calculated. (auth)

9100 ISOTOPE EFFECT OF HYDROGEN IN THE BROMINATION OF 1,3,5-TRIMETHOXYBENZENE WITH N-BROMOSUCCINIMIDE IN DIMETHYLFORMAMIDE. Erik Helgstrand (Nobel Inst. of Chemistry, Stockholm). Acta Chem. Scand., 18: 1616-22(1964).

The reaction studied apparently involves a rate-determining step in which free Br_2 is formed from N-bromosuccinimide and hydrobromic acid and a fast product-determining step in which free Br_2 reacts with the substrate, forming 1-bromo-2,4,6-trimethoxybenzene and hydrobromic acid. The free Br_2 that starts the reaction is generated by a decomposition reaction of N-bromosuccinimide, probably influenced by the solvent dimethylformamide with its slight content of water. The product-determining step was investigated in competitive experiments with tritium, and the isotope effect, k_T/k_H was found to be 1.00 ± 0.03 at 20°C. This is discussed in relation to previous work. (auth)

9101 ON THE CRYSTAL STRUCTURE OF $MoAs_2$. Per Jensen and Arne Kjekshus (Universitetet, Oslo). Acta Chem. Scand., 18: 1798-1800(1964).

In the Mo−As system three intermediate phases were identified. A discussion of the $MoAs_2$ phase is presented along with Guinier photograph data on this phase. (J.R.D.)

9102 ON SOME FACTORS AFFECTING THE ISOTOPIC EXCHANGE OF IODINE ATOMS. E. Köroes, L. Pataki, L. Ladányi, M. Orbán, and V. Keresztes-Hamar (Eötvös Univ., Budapest). Acta Chim. Acad. Sci. Hung., 41: 172-86(1964).

The effect of the temperature, the nitro-group, and the azine-nitrogen on the isotopic exchange of iodine between I_2 and I-antipyrine was studied. The exchange reaction had activation energy in aliphatic alcohols, but not in benzene, in chloroform, or in a mixture of benzene-nitrobenzene. The presence of nitro-compounds (both aromatic and aliphatic) accelerated the exchange reaction. Log $t_{½}$ (the halftime of the exchange) plotted against the concentration of the nitro-compounds gave straight lines. The accelerating effect of the nitro-compound depended on the solvent, too. An accelerating coefficient ($\mathfrak{I}$) term was introduced; making it possible to distinguish between the accelerating power of the nitro-compounds. The azine-nitrogen retarded the exchange reaction due to a strong interaction with I_2. The values for $t_{1/2}$ plotted against the concentration of the azines, gave straight lines. The retardation can be expressed by the retardation coefficient, δ. Some azines in very low concentrations showed accelerating effects where the exponential relation between $t_{1/2}$ and the concentration was valid. Explanations for this effect are also given. (auth)

9103 THE ANOMALOUS BEHAVIOUR OF THE NEUTRON REFLEXIONS OF FLUORITE. B. T. M. Willis (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Acta Cryst., 18: 75-6(Jan. 10, 1965).

At room temperature the neutron intensities of the Bragg reflexions of CaF_2 could not be interpreted satisfactorily by the ideal fluorite model, with calcium atoms at the 000, $\frac{1}{2}\frac{1}{2}0$, $\frac{1}{2}0\frac{1}{2}$, $0\frac{1}{2}\frac{1}{2}$ positions of the cubic cell, fluorine atoms at $\frac{1}{4}\frac{1}{4}\frac{1}{4}$, $\frac{1}{4}\frac{1}{4}\frac{3}{4}$ ... etc. and with all atoms executing isotropic thermal motion. Closer agreement with the observed data was obtained by assuming that the fluorine atoms are displaced slightly towards the centers of the interstices, which surround each fluorine tetrahedrally. This displacement could be ascribed to the anharmonic vibration of the fluorine atoms about their ideal positions. A similar effect was reported previously for UO_2 and ThO_2 at high temperatures. (auth)

9104 GROWTH OF POTASSIUM TANTALATE-NIOBATE SINGLE CRYSTALS FOR OPTICAL APPLICATIONS. W. A. Bonner, E. F. Dearborn, and L. G. Van Uitert (Bell Telephone Labs., Inc., Murray Hill, N. J.). Am. Ceram. Soc. Bull., 44: 9-11(Jan. 1965).

A modification of the Kyropoulos technique was employed for growing large crystals of potassium tantalate-niobate for optical modulator and other device applications. Effects of impurities, controlled chemical additions, oxygen circulation over the melt, growth rate, seed rotation, and melt agitation on crystal growth are considered. Large changes in dielectric constant with measuring direction were observed for the tetragonal to orthorhombic transition in samples that exhibited a lamellar pattern between crossed polaroids. (auth)

9105 THE VALENCE COMPOUNDS OF THE NOBLE GASES. R. Hoppe (Universität, Munster, Ger.). Angew. Chem., 76: 455-63(June 11, 1964). (In German)

A review with 121 references is presented. In the introduction, note is given to molecules containing He which exist in excited states, and to rare gas hydrates, rare gas double hydrates (containing an organic compound as the second species in water) and cage compounds with hydroquinone. Earlier attempts and investigations are discussed. The first preparation of noble gas fluorides is discussed, with the question of priority for the German group under Hoppe against that for the American group under Claassen being raised; a brief history of the German effort is included. A short section on preparation of noble gas compounds is given. Particular detail is given to the preparation, chemical and physical properties, and reactions of XeF_2 and XeF_4. The chemistry of the higher fluorides and oxyfluorides of Xe is outlined, together with that of the fluorides of Kr, fluorine compounds of higher order, and oxygen compounds of Xe. A section on the thermochemistry of these compounds and on bond properties is included, and a general discussion of progress in the field completes the article. (BBB)

9106 NMR MEASUREMENTS OF FIELD GRADIENTS AT I^{127} NUCLEI SURROUNDING A SUBSTITUTIONAL Rb ION IN A KI CRYSTAL. Lars-Olov Andersson and Erik Forslind (Royal Inst. of Tech., Stockholm). Arkiv Fysik, 28: 49-66(1964).

The second order quadrupole shifts of the nuclear magnetic resonance lines corresponding to transitions between the energy levels with the magnetic quantum numbers $m = \frac{1}{2}$ and $m = -\frac{1}{2}$ were studied in order to determine the electric field gradient tensors at nuclei surrounding a substitutional ion in a crystal lattice of the NaCl type. The systematic study of symmetry effects in the orientation of the field gradient tensors at nuclei with different positions in relation to the impurity ion shows how an identification of the observed resonance lines may be made. The measurements were made on ^{127}I nuclei of a KI crystal with a small concentration of Rb ions and the field gradient tensors and their orientations relative to the crystal axes were determined at the nuclei with the general positions (2,1,0), (3,0,0), and (3,2,0) measured in units of the interionic distance along the crystal axes from the substitutional ion. (auth)

9107 THERMODYNAMIC CALCULATIONS OF SODIUM REACTION WITH WATER FOR A SODIUM-WATER TYPE SUPERHEATER. N. N. Ivanovskii and F. A. Kozlov. At. Energ. (USSR), 17: 406-8(Nov. 1964). (In Russian)

The chemical reaction of Na with water is considered in three steps: $Na + H_2O \rightleftharpoons NaOH + \frac{1}{2} H_2$, $2 Na + NaOH \rightleftharpoons Na_2O + NaH$, and $NaH \rightleftharpoons Na + \frac{1}{2} H_2$, assuming that water leakage into the sodium is small enough that there is no significant temperature increase. The equilibrium constants of the reactions were calculated on the basis of published data. The results of the thermodynamic calculations are given. The change of the isobaric potential of the reactions is shown as a function of temperature. Expressions for the equilibrium concentrations of the reaction products were derived, and numerical calculations were performed using previous experimental data. (M.J.T.)

9108 THE COPRECIPITATION OF YTTRIUM WITH CALCIUM OXALATE. Tsunenobu Shigematsu, Masayuki Tabushi, and Masakazu Matsui (Kyoto Univ.). Bull. Chem. Soc. Japan, 37: 1610-13(Nov. 1964).

The coprecipitation of yttrium with calcium oxalate was studied using ^{91}Y as a tracer. The effects of pH, the ratio of tracer component to carrier, the concentration of the buffer solution, and several other variables on the distribution coefficient were investigated. (M.C.G.)

9109 CRYSTAL STRUCTURE OF ZIRCONIUM TRICHLORIDE. B. Swaroop and S. N. Flengas (Univ. of Toronto). Can. J. Phys., 42: 1886-9(Oct. 1964).

The crystal structure of zirconium trichloride was determined from x-ray diffraction patterns. Zirconium trichloride belongs to the $P\bar{3}m1$ space group. The dimensions of the main cell at room temperature are $\alpha = 5.961 \pm 0.005$ Å and $c = 9.669 \pm 0.005$ Å. The density of zirconium trichloride was measured to be 2.281 ± 0.075 g/cm³ while, from the x-ray calculations, the value was found to be 2.205 g/cm³. (auth)

9110 CONTRIBUTION TO THE STUDY OF THE OXIDES OF PROTACTINIUM. Tatiana Stchouzkoy, Henri Pezerat Georges Bouissieres, and Roland Muxart (Inst. of Radium, Arcueil, France and National Inst. of Chemical Industrious Research, Arcueil, France). Compt. Rend., 259: 3016-18(Nov. 2, 1964). (In French)

The crystalline form of the protactinium oxides obtained under different experimental conditions was examined systematically. The effects of the method of preparation and of the temperature of calcination on crystal structure were studied. (tr-auth)

9111 X-RAY ABSORPTION SPECTRA L_{III}- FOR LANTHANUM AND CERIUM IN NON-METALLIC COMPOUNDS. I. A. Ovsyannikova, E. E. Vainshtein, and G. V. Samsonov (Inst. of Inorganic Chemistry, Academy of Sciences, Siberia SSR and Inst. of Metalloceramics and Special Alloys, USSR). Fiz. Metal. i Metalloved., 18: 637-8(Oct. 1964). (In Russian)

X-ray absorption spectra L_{III} for lanthanum in La_2O_3, La_2O_2S, La_2C, LaC_2, La_2S_3, LaS, and LaP and for cerium in Ce_2S_3 and CeS were studied. Diagrams are given of the relative energy positions for the La L_{III} maxima in various compounds and for L_{III} absorption of cerium in mono- and sesquisulfides. (R.V.J.)

9112 THE KINETIC ISOTOPE EFFECT IN THE BACTERIAL REDUCTION AND OXIDATION OF SULFUR. Nobuyuki Nakai (Nagoya Univ., Japan) and M. L. Jensen. Geochim. Cosmochim. Acta, 28: 1893-1912(Dec. 1964).

The kinetic isotope effect in bacterial reduction of sulfate to sulfide and oxidation of native sulfur and sulfide to sulfate was investigated at the temperature of 32°C. In these studies, mixed culture techniques were used in order to more closely approximate isotopic fractionation as it occurs in nature. In addition, the $\delta^{34}S$ compositions of sulfur in coexisting sulfate and sulfide in lake waters and streams were determined for comparison to the laboratory raw culture results. (auth)

9113 URANYL CHELATES OF SCHIFF BASES. Chin-huei Lo. Hua Hsueh Hsueh Pao, 29: 243-8(1963).

Eight new chelates were prepared from uranyl nitrate and Schiff bases, all containing two molecules of nitric acid to satisfy the coordination number of uranium, which is eight in these complexes. Results of thermogravimetric analysis of these complexes showed that the two nitric acid molecules are in the inner sphere and coordinated directly to uranium. Molar conductivities of the complexes in methyl alcohol and pyridine solutions were determined and the results indicate that they resemble II-I type electrolytes in conductance. Solubilities of the complexes in ethyl alcohol at 25°C were also determined. (Sci. Abstr. China, Chem. Chem. Technol., 2: No. 2, 1964)

9114 ANALYSIS OF THE ABSORPTION SPECTRUM OF CESIUM URANIUM(V) HEXAFLUORIDE. Martin J. Reisfeld and Glenn A. Crosby (Los Alamos Scientific Lab., N. Mex.). Inorg. Chem., 4: 65-70(Jan. 1965). (LA-DC-6519)

The optical absorption spectrum of $CsUF_6$ was measured at 300 to 50,000 cm^{-1}, and the results analyzed in terms of the crystal field theory. The UF_6^- ion, characterized by a single 5f electron on the U, has a slightly distorted octahedral configuration. The crystal field parameters found are $\zeta_{5f} = 1955\ cm^{-1}$, $A_4^0\langle r^4\rangle = 2351\ cm^{-1}$, and $A_6^0\langle r^6\rangle = 208.8\ cm^{-1}$. The spectrum is largely vibronic in character, and values of the fundamental vibrational frequencies were deduced from the splittings observed in the near-infrared and visible regions. (auth)

9115 PREPARATION OF SINGLE CRYSTALS OF COMPLEX PEROVSKITE FERROELECTRIC AND SEMICONDUCTING COMPOUNDS. Francis Galasso and Wilda Darby (United Aircraft Corp., East Hartford, Conn.). Inorg. Chem., 4: 71-3(Jan. 1965).

Single crystals of ferroelectric perovskite-type compounds with the general formula $Pb(B'_{0.5}B''_{0.5})O_3$ where B′ is Sc or Fe and B″ is Nb or Ta and single crystals of some new semiconducting perovskite-type compounds with the general formula $La(B'_{0.5}B''_{0.5})O_3$ where B′ is a divalent ion and B″ is Ru or Ir were prepared from a flux and characterized by means of x-ray-diffraction. Resistivity vs. temperature measurements made on crystals of two of the compounds, $La(Ni_{0.5}Ru_{0.5})O_3$ and $La(Mg_{0.5}Ru_{0.5})O_3$ showed that they exhibited typical semiconductor behavior with conduction activation energies of 0.120 and 0.046 ev, respectively. (auth)

9116 SOLID STATE STUDIES ON TUNGSTEN TRIOXIDE SINGLE CRYSTALS BELOW ROOM TEMPERATURE. Billy Lee Crowder and M. J. Sienko (Cornell Univ., Ithaca, N. Y.). Inorg. Chem., 4: 73-7(Jan. 1965).

The Hall voltage, electrical resistivity, and thermoelectric power were measured as a function of temperature on single crystals of WO_3 at 140 to 300°K. Discontinuities appear on cooling at approximately +10 and −40°, corresponding, respectively, to a monoclinic-to-triclinic (γ-to-β) and a piezoelectric-to-ferroelectric (β-to-α) transition. The γ-to-β transition is strongly dependent on the domain characteristics and the impurity concentrations of the individual crystals. Introduction of oxygen vacancies leads to disappearance of the discontinuities at +10 and −40°. (auth)

9117 RARE EARTH METAL−METAL HALIDE SYSTEMS. VII. THE PHASES GADOLINIUM 1.6−CHLORIDE AND GADOLINIUM DIIODIDE. Jack E. Mee and John D. Corbett (Ames Lab., Ames, Iowa). Inorg. Chem., 4: 88-93 (Jan. 1965).

The salt-rich portions of the equilibrium phase diagrams for the systems $GdCl_3$−Gd and GdI_3−Gd were determined. The reaction of Gd with molten $GdCl_3$ is small above 632°C (2 mole % Gd at 670°C), but at lower temperatures the highly reduced solid $GdCl_{1.58\pm0.06}$ is formed. The probable composition limits were inferred from powder pattern data for samples with $Cl/Gd \geq 1.61$. The compound has a salt-like electrical resistance and exhibits a paramagnetic moment of 8.0 B.M., with antiferromagnetic ordering below 50°K. The possible constitution of the phase is considered in terms of $[Xe]4f^7 5d^1$ and $[Xe]4f^7 5d^2$ states for the reduced Gd. A more substantial reaction of metal is found with liquid GdI_3, 14 mole % at 850°C, and the phase $GdI_{2.04\pm0.04}$ separates incongruently at 831°C. A practical synthesis of the pure compound was prevented by the proximity of the 825°C eutectic, so that the probable composition was again bracketed from x ray powder data for samples with $I/Gd \geq 2.11$. The brass-colored diiodide is evidently metallic in character $[Gd^{3+}(I^-)_2e^-]$ and is ferromagnetic below about 330°K. Energy and structural considerations that appear important in determining a metallic vs. a salt-like constitution for such compounds are also presented. (auth)

9118 SOME OBSERVATIONS ON URANIUM−NITROGEN COMPOUNDS. C. E. Price and I. H. Warren (Univ. of British Columbia, Vancouver). Inorg. Chem., 4: 115-16 (Jan. 1965).

The preparation and properties of UN_2 were studied along with the preparation and structure of U_2N_3. Room temperature thermoelectric data on UN_2 were obtained, and it was found that U_3N_2 exists as a stable phase. The existence of a UN phase with excess N_2 appears doubtful. (J.R.D.)

9119 PARATUNGSTATE ION. William N. Lipscomb (Harvard Univ., Cambridge, Mass.). Inorg. Chem., 4: 132-4(Jan. 1965).

A proposed model of the paratungstate ion is presented. The proposed formula is $W_{12}O_{42}^{-12}$ or a protonated version such as $H_2W_{12}O_{42}^{-10}$. Supporting evidence for the model is given. (J.R.D.)

9120 VOLATILITY OF PuO_2 IN NONREDUCING ATMOSPHERES. William M. Pardue and Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). J. Am. Ceram. Soc., 47: 610-14(Dec. 21, 1964).

The vapor pressure of plutonium dioxide (PuO_2) was investigated in the range from 1450 to 1775°C in air, argon, and oxygen atmospheres by a transpiration technique. There were strong indications that PuO_2 can vaporize congruently or as a suboxide species, depending on the atmosphere. The ΔH_{298}^0 for vaporization in 1 atm of oxygen was approximately 154,000 cal per mole. The estimated standard free energy of formation (ΔG_f^0) of gaseous PuO_2 is −121,000 + 10.7 T from 1227 to 1827°C. (auth)

9121 INFRARED ABSORPTION SPECTROSCOPY IN ZIRCONIA RESEARCH. Neil T. McDevitt and William L. Baun (Air Force Materials Lab., Wright Patterson AFB, Ohio). J. Am. Ceram. Soc., 47: 622-4(Dec. 21, 1964).

Infrared absorption spectra are shown for monoclinic ZrO_2 and for cubic stabilized ZrO_2. Nine bands are reported in monoclinic ZrO_2 in the region from 800 to 200 cm^{-1}, whereas only one broad band was observed in cubic ZrO_2 over the same frequency range. (auth)

9122 REACTIONS OF ZIRCONIA AND CHROMIUM. Robert Ruh and Harold J. Garrett (Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Am. Ceram. Soc., 47: 627-9(Dec. 21, 1964).

Investigations were undertaken to determine the solubility of chromium in zirconia and to study the reactions occurring between Cr and ZrO_2. Data from weight change measurements, chemical analyses, metallographic analyses, microhardness studies, and electron probe analyses indicated that Cr contents up to 1% were retained in solid solution in ZrO_2. Data from lattice parameter measurements indicated that neither zirconium nor oxygen is retained in solid solution in chromium. (M.C.G.)

9123 NORMAL SPECTRAL EMITTANCE (0.65μ) OF TaC–HfC SOLID SOLUTIONS AND TUNGSTEN ABOVE 1600°C. Daniel Deadmore (Lewis Research Center, Cleveland). J. Am. Ceram. Soc., 47: 649-50(Dec. 21, 1964).

The normal spectral emittance of tungsten and single-phase, fcc carbides in the system TaC–HfC was measured. The specimens were directly heated by induction in a vacuum furnace at 10^{-5} to 10^{-6} torr. Emittance was determined from the corresponding surface and blackbody temperature measurements. These emittance values were plotted against blackbody temperatures. (M.C.G.)

9124 THE PREPARATION AND NUCLEAR MAGNETIC RESONANCE OF KRYPTON DIFLUORIDE. F. Schreiner, J. G. Malm, and J. C. Hindman (Argonne National Lab., Ill.). J. Am. Chem. Soc., 87: 25-8(Jan. 5, 1965).

Krypton difluoride was prepared by passing an electric discharge through a mixture of the elements at low pressure (~20 mm.) and low temperature (−183°C). This method was reported previously to yield krypton tetrafluoride, a claim which could not be substantiated by the present work. The compound obtained is a white crystalline solid which sublimes at temperatures well below 0°C and can be handled in dry, Pyrex glass or polychlorotrifluoroethylene containers. It is a highly reactive fluorinating agent which may be kept at dry ice temperature. At room temperature spontaneous decomposition occurs. Analytical data are given which establish the formula KrF_2. Also, nuclear magnetic resonance measurements of the chemical shift for fluorine-19 of KrF_2 dissolved in anhydrous hydrofluoric acid are reported. The shielding value σ_F^a is found to be 374×10^{-6} for a solution of 4.6 moles of KrF_2/kg. of HF and 362×10^{-6} for a solution of 16.4 moles of KrF_2/kg. of HF, both measured at 0°. These values agree with the value reported for a sample of krypton tetrafluoride (373×10^{-6}) which provides evidence that, in fact, the measurements were performed on krypton difluoride. Theoretical considerations treating the bonding in KrF_2 as analogous to that in XeF_2 lead to a shielding value which is in excellent agreement with the experimental one. (auth)

9125 MECHANISM OF THE OXIDATION OF ZIRCONIUM IN OXYGEN AND LIQUID SODIUM. Tennyson Smith (North American Aviation Science Center, Thousand Oaks, Calif.). J. Electrochem. Soc., 112: 39-46(Jan. 1965).

An analysis using Fick's second law diffusion equation (for film growth and diffusion into the metal) is given which explains the observed variation of apparent activation energy between about 28 and 50 kcal/mole for the oxidation process. The observed differences between oxidation in O_2 and oxidation by O_2 in liquid Na is also explained. An empirical equation is given that accurately describes the experimental data of weight gain vs. time (for Zr, Ti, and Cu) as this relationship goes from approximately parabolic, to quasi-cubic, to parabolic again. The derivation of this equation stems from the hypothesis that the diffusion coefficient (for O_2 into the metal) decreases as the O_2 consumption increases. (auth)

9126 THE REACTION OF HYDROGEN WITH GRAPHITE AT 1200° TO 1650°C. Earl A. Gulbransen, Kenneth F. Andrew, and Fred A. Brassart (Westinghouse Electric Corp., Pittsburgh). J. Electrochem. Soc., 112: 49-52(Jan. 1965).

The reaction was studied at 19 Torr under static and flow conditions. Rates of reaction up to 6.0×10^{17} atoms of C per cm^2-sec were measured at 1650°C and 19 Torr. The rates of reaction were nearly independent of flow and pressure. The kinetic data could be fitted to an Arrhenius-type equation $dn'/dt = Ke^{-\Delta H/RT}$, where $\Delta H = 72 \pm 2$ kcal/mole. Mass spectrometer studies of the reacted gases in the flow experiments showed no evidence for CH_4 and other C-H gases. This was interpreted as evidence for the decomposition of C-H compounds immediately after reaction. Since the reaction products cannot form a barrier layer, a chemical mechanism was proposed for the reaction for both flow and static conditions. (auth)

9127 ON THE LUMINESCENT PROPERTIES OF THE RARE EARTH VANADATES. L. H. Brixner and E. Abramson (E. I. du Pont de Nemours Co., Wilmington, Del.). J. Electrochem. Soc., 112: 70-4(Jan. 1965).

Results of x-ray examination of Ln_2O_3/V_2O_5 systems indicated that compounds of the $LnVO_4$ type are the only ones formed by the rare earth sesquioxides and vanadium pentoxide. On the basis of this finding, a flux-growing technique employing a V_2O_5 melt for the preparation of all rare earth vanadates in single crystalline form was developed. Using monocrystals and polycrystalline material the fluorescent emission of the rare earth vanadates was studied. Resulting data are analyzed. (auth)

9128 CHEMICAL AND OPTICAL STUDIES OF SAMARIUM DOPED CaF_2 TYPE SINGLE CRYSTALS. P. F. Weller, J. D. Axe, and G. D. Pettit (International Business Machines Corp., Yorktown Heights, N. Y.). J. Electrochem. Soc., 112: 74-7(Jan. 1965).

Single crystals of CaF_2 and $Ca_{1-x}Sr_xF_2$ were grown by the Czochralski technique and doped with varying concentrations of Sm. Complete solid solution was found in the CaF_2-SrF_2 pseudobinary system with a minimum near 50% CaF_2 at 1300° ± 10°C. The concentration of Sm^{+2} depended on the melt concentrations of SmF_3 and Sm metal, and the Sm segregation coefficient did not change significantly with Sm concentration. The fluorescence efficiency of Sm^{+2} as a function of Sm^{+2} concentration appeared to go to a broad maximum at about 0.1% Sm^{+2}. The fluorescent emission in $Ca_{1-x}Sr_xF_2:Sm^{+2}$ showed pronounced inhomogeneous line broadening. (auth)

9129 BOMB REDUCTION OF TANTALUM PENTOXIDE BY CALCIUM METAL. C. K. Gupta and P. K. Jena (Atomic Energy Establishment, Trombay, India). J. Less-Common Metals, 8: 90-8(Feb. 1965).

Massive tantalum metal was produced by calciothermic reduction of tantalum pentoxide in a refractory-lined steel bomb using sulfur as the thermal booster. The reaction was initiated by placing the bomb in a preheated furnace. Experimental variables such as the scale of reduction, amount of sulfur by weight of the oxide and the amount of calcium in excess of the stoichiometric requirement, were studied at a bomb wall temperature of about 500°C. The as-reduced metal was subjected to non-consumable arc melting and electron-beam melting to improve its physical and mechanical properties. Marked improvement in purity and workability of the electron-beam-melted metal as compared with the arc-melted was observed. A cold reduction of over 96% without intermediate annealing was possible on the metal obtained after electron-beam melting. Products like wire-rods, strips, and wires could be fabricated from the electron-beam-melted metal with ease. (auth)

9130 A GEOMETRIC EFFECT AT THE SOLUTION-SURFACE INTERFACE AND ITS RELATIONSHIP TO ION SOLVATION. Bobby L. McConnell, Kenneth C. Williams, John L. Daniel, Jimmy H. Stanton, Bobby N. Irby, Donald L. Dugger, and Russell W. Maatman (Univ. of Mississippi, University). J. Phys. Chem., 68: 2941-6(1964). (TID-19775)

The consequences of diminished concentration of the larger species in solution near a solution–phase boundary are discussed. The diminished concentration, a geometric effect, while general and not dependent upon the absence of other reactions, is experimentally observable only in systems in which the interface-to-volume ratio is hundreds of square meters per milliliter. This condition is sometimes met in colloidal systems. A method for treating quantitatively the geometric effect in solution–gel systems is presented. Use of the method is illustrated by considering ion–gel–water systems; estimates of the radii of 42 solvated ions are given. All radii calculated are in the range found by other methods, suggesting that the geometric interpretation of the experimental results is correct. (auth)

9131 THE MÖSSBAUER STUDY OF THE FERROUS ION IN $FeCl_2$. Kazuo Ôno, Atsuko Ito, and Toshizo Fujita (Tokyo Univ.). J. Phys. Soc. Japan, 19: 2119-26(Nov. 1964).

The Mössbauer spectra of ^{57}Fe in $FeCl_2$ were measured over the temperature range of 1.5–530°K. The temperature dependence of the observed $e^2qQ/2$ is fairly strong. Even below the Néel temperature of 24°K, the spectra showed only two absorption lines due to the electric field gradient at the iron nucleus and did not show any typical pattern of six absorption lines due to the internal magnetic field. The quadrupole splitting changed abruptly by about 30% through the Néel temperature. The parameters obtained are as follows; $e^2qQ/2 = 0.80$ mm/sec, $\delta = 1.26$ mm/sec at room temperature (above the Néel temperature) and $e^2qQ/2 = 1.36$ mm/sec, $\delta = 1.50$ mm/sec and $H_{int} = 0 \pm 8$ koe at liquid helium temperature (below the Néel temperature). These characteristic features are completely explained with the following hamiltonian for ferrous ion in the orbital triplet; $H = \lambda' lS - \Delta(l_z^2 - 2/3) - 2\,Jx < S_z > S_z$ with the values of $\lambda' = 95\ cm^{-1}$, $\Delta = 119\ cm^{-1}$ and $2Jx = 7.3\ cm^{-1}$. (auth)

9132 NET-PATTERN IN MIXED CRYSTALS OF BARIUM-STRONTIUM TITANATE. Hiromu Sasaki (Matsushita Electric Industrial Co. Ltd., Osaka). J. Phys. Soc. Japan, 19: 2238-9(Nov. 1964).

Observations of a net-pattern in mixed crystals of (Ba, Sr) TiO_3 are described. The crystals have the Curie point of ~110°C and exhibit a peculiar feature of a regularly arranged net-pattern under a polarizing microscope. The rows of the pattern are along the [100] direction of the crystal. The dark portions are in a perfect extinction corresponding to the c-domain. The bright portions show extinction along the [100] and [010] direction. The net-pattern is attributed to the Sr ions substituted for a part of the Ba sites which cause the stresses probably due to the difference of ionic radius between Ba and Sr. (C.E.S.)

9133 PLASMA OSCILLATION OF ELECTRONS IN LiF. Osamu Sueoka (Tokyo Univ.). J. Phys. Soc. Japan, 19: 2239(Nov. 1964).

The characteristic energy loss of electrons that passed through a thin foil of LiF was studied using the transmission technique. The dispersion relation and the cut off scattering angle of the 25-ev peak were measured to determine whether or not the plasma oscillation exists in ionic crystals such as LiF. It is concluded that the plasma oscillation exists in LiF though the lifetime of the oscillation may be very short. (C.E.S.)

9134 ELECTRON SPIN RELAXATION TIME OF HEAVILY P^{31} DOPED SILICON. Shigeru Maekawa and Nobumori Kinoshita (Electrotechnical Lab., Tokyo). J. Phys. Soc. Japan, 19: 2240-1(Nov. 1964).

ESR measurements in ^{31}P doped silicon were performed at liquid helium temperatures and at X-band frequency. Magnetic field modulation with 0.3 and 1.0 kc was used. The relation between carrier concentration and electron spin relaxation rate at 4.2 and 1.5°K was determined. (C.E.S.)

9135 ELECTRON SPIN RESONANCE OF Eu^{2+} AND Gd^{3+} IN CaF_2. Kazumi Horai (Nagoya Univ., Japan). J. Phys. Soc. Japan, 19: 2241-2(Nov. 1964).

The ESR of Eu^{2+} and Gd^{3+} in CaF_2 was observed at a frequency of about 9200 Mc and at temperatures between 1.4 and 290°K. The parameters of the spin-hamiltonian and the spin-lattice relaxation times were determined from the position of the resonance lines and from the intensities of the successively saturated resonance lines. (C.E.S.)

9136 METAL PRECIPITATION WITH ISOMERS OF DIMETHYLPHENYLARSONIC ACID. R. Pietsch and P. Ludwig (Universität, Graz). Mikrochim. Ichnoanal. Acta, No. 5-6, 1007-13(1963). (In German)

Changes in the precipitation-pH values of a number of metal ions were studied in a system investigation of the precipitating action of various dimethylphenylarsonic acids in regard to the position of the methyl groups on the aromatic nucleus. By comparison with the action of non-substituted phenylarsonic acid and with the action of the monomethylphenylarsonic acids, it was possible to detect relationships between the position of the methyl groups on the aromatic nucleus and the precipitating action of the acids. (auth)

9137 METAL PRECIPITATION WITH 2,4,5- AND 2,4,6-TRICHLOROPHENYLARSONIC ACID. R. Pietsch and P. Ludwig (Universität, Graz). Mikrochim. Ichnoanal. Acta, No. 5-6, 1027-32(1963). (In German)

The ability of phenylarsonic acid to form metal salts, which resides in its AsO_3H_2-group, is enhanced by the introduction of three chlorine atoms into the nucleus. The extent of the lowering of the pH values of the beginning of the metal precipitations can be explained through analogous changes that occur in the case of various monochlorophenylarsonic acids. The influence of steric hindrance by single or twofold ortho- substitution could be seen in the case of 2,4,5- and 2,4,6-trichlorophenylarsonic acid. (auth)

9138 ELECTRON DIFFRACTION STUDY OF EVAPORATED BERYLLIA. J. M. Cowley (Univ. of Melbourne). Nature, 204: 1082(Dec. 12, 1964).

In an investigation of BeO crystal disintegration under electron irradiation it was found that crystals condensing on surrounding C film take the form of comparatively large thin crystal plates. An analysis of the rotation patterns given by a crystal or a set of parallel crystals bent around one axis is presented. (J.R.D.)

9139 MÖSSBAUER EFFECT OF SOME IRON SALTS IN ICE. I. Dézsi (Central Research Inst. of Physics, Budapest), L. Keszthelyi, L. Pocs, and L. Korecz. Phys. Letters, 14: 14-16(Jan. 1, 1965).

An investigation of the Mössbauer effect on frozen aqueous solutions of some well dissociable iron salts is discussed. The dissolved salts were $FeCl_2$, $Fe(ClO_4)_2$, $FeSO_4$, $FeSO_4 \cdot (NH_4)_2SO_4$, $FeCl_3$, $Fe(ClO_4)_3$, $Fe_2(SO_4)_3$, and $K_4[Fe(CN)_6]$. The frozen solutions were put in a cryostat at −191°C and, after measurements were taken, were warmed slowly to −70°C. The thickness of Fe was 0.4 mg/cm^2 (enriched to 72% in ^{57}Fe) corresponding to 0.35 wt. % in water. (C.E.S.)

9140 DYNAMIC NUCLEAR POLARIZATION IN LIQUIDS AT 13,000 GAUSS. R. Van Steenwinkel and K. H. Hausser (Max-Planck Institut, Heidelberg). Phys. Letters, 14: 24-5(Jan. 1, 1965).

The dynamic nuclear polarization, due to the Overhauser effect, of solvent protons in free radical solutions at magnetic fields of about 13,000 gauss was measured. Solutions of various concentrations of 1,3-bisdiphenylene-2-p-chlorphenylallyl in benzene at room temperature were used. The inverse enhancement factor of the solvent protons was determined. (C.E.S.)

9141 KNIGHT SHIFTS AND RELAXATION TIMES IN THE GROUP IIIb METALS AND METAL–HYDROGEN SYSTEMS. D. S. Schreiber (Northwestern Univ., Evanston, Ill.). Phys. Rev., 137: A860-4(Feb. 1, 1965).

The Knight shifts K of the Group IIIb metals Sc and Y alloyed with hydrogen, and T_1T of Sc in the Sc-H system, were determined and are compared with K and T_1T of pure La, Y, and Sc and of La in the La-H system. It is found that K_{Sc} and T_1T_{Sc} (in ScH_2) are 0.07% and 25 sec-°K, respectively while K_Y (in YH_2) is 0.11%. The ratio $K_{Me\,H_2}/K_{Me} = 0.33 \pm 0.03$ for each metal Me = La, Y, or Sc while $T_1T_{Me\,H_2}/T_1T_{Me} = 2.2 \times 10^2$. The similarity in the ratio of K's and T_1T's is shown to suggest a similarity in the electronic band structure in the Group IIIb metals and their H alloys. The assumption of a large orbital contribution, dominating the s and d core polarization terms, to K and T_1 is shown to be consistent with the results. H alloying is interpreted in terms of hydrogen entering the metal interstitially as a bare proton, its electron being ionized and donated to the conduction band of the metal. A Korringa-like relation embodying s, d, and orbital effects is developed and shows a similarity in the band structure of La and Sc without considering H alloying. It is shown that $K^2T_1T = \rho^2(\hbar/4\pi k)\ (\gamma_e/\gamma_n)^2$, where ρ is explicitly given as a function of the s, d, and orbital contributions. For the pure metals, $\rho = 0.37 \pm 0.01$ while for the H alloys, $\rho = 1.9 \pm 0.2$. T_1T for Y and for Y in YH_2 is predicted. (auth)

9142 EFFECTS OF DYNAMIC LATTICE DISTORTIONS ON THE STRUCTURE OF THE F BAND IN THE CESIUM HALIDES. P. R. Moran (Univ. of Illinois, Urbana). Phys. Rev., 137: A1016-27(Feb. 1, 1965). (COO-1198-206)

The smooth, nearly Gaussian, optical absorption band of F centers in most alkali halides contrasts with that observed at low temperatures in the cesium halides, where two or sometimes three components are partially resolved. A strong spin-orbit coupling could account for two components, but the third has remained a mystery because of the cubic symmetry of the alkali-halide lattice. The calculations show that the cesium halide F-band structure can be explained by the instantaneous distortion of the F center's environment from cubic symmetry induced by the motion of the lattice. The optical absorption line shapes and the low-temperature magneto-optic properties of the F center are calculated by using perturbation theory to describe the noncubic electron-vibrational interactions in the limit of strong spin-orbit coupling and by using the Franck–Condon approximation to treat the distribution of vibrational distortions of both cubic and noncubic symmetry. The approximate line shapes obtained have three components corresponding to the three excited state Kramers doublets and can be brought into good agreement with the experimental results for CsI, CsBr, CsCl, and CsF by a suitable choice of the interaction parameters for each material. The same parameters satisfactorily account for the observed circular dichroism and Faraday rotation. A qualitative explanation of the effect of changing the halogen is given in terms of the physical properties of the halogen ions and the manner in which their motion diminishes the cubic interactions and enhances the noncubic interactions. The influence of the temperature upon the structure is also discussed. The different relative strengths of the various interactions account for the striking contrast between the cesium-halide F bands and those observed in the salts which have a relatively light alkali. (auth)

9143 DETERMINATION OF THE EFFECTIVE MASS OF ELECTRONS IN HgTe. L. Śniadower, V. I. Ivanov-Omsky, and Z. Dziuba (Inst. of Physics, Polish Academy of Sciences, Warsaw). Phys. Status Solidi, 8: K43-5(1965).

Measurements were made of plasma magneto-reflection in the region of the plasma minimum for n-type HgTe samples. From the splitting of the plasma minimum the effective mass of electrons was estimated. Then the dielectric constant in the absence of any contribution of free carriers was calculated. (M.C.G.)

9144 DETERMINATION OF IONIC WEIGHTS OF THORIUM FORMATE AND THORIUM ACETATE WITH THE HELP OF THE DIALYSIS METHOD. Barbara Frank (Uniwersytetu Curie-Sklodowskiej, Lublin). Roczniki Chem., 38: 1469-72(1964). (In Polish)

Coefficients of dialysis of solutions of thorium acetate in potassium and ammonium acetate and of thorium formate in potassium and ammonium formate were determined. From the values of the coefficients the ionic weight was calculated and probable formulas are given. (auth)

9145 ON THE VACUUM REDUCTION PROCESS FOR THE PRODUCTION OF NIOBIUM METAL. Hirozô Kimura and Yasuo Sasaki. Trans. Natl. Res. Inst. Metals (Tokyo), 5: 213-18(1963).

Using the vacuum process, carbide reduction of niobium pentoxide due to the reaction $Nb_2O_5 + 5\ NbC = 7\ Nb + 5\ CO$ was investigated experimentally. The mixing ratio of Nb_2O_5/NbC was varied from 33/67 to 45/55. By means of fluctuation measurements of pressure and temperature, it was determined that the reaction proceeds rapidly above 1700°C. Crude niobium metal, containing 96 to 97% Nb, was obtained easily by this process. Purification of the crude niobium metal was examined in a series of vacuum refining experiments. Impurities, such as carbon, oxygen, and nitrogen in niobium metal decreased at refining temperatures above 2150°C at a pressure of 10^{-5} mmHg. Removal of carbon during the refining process was dependent on both the temperature and the oxygen content. Rapid removal of oxygen was observed in the presence of carbon. Cold-rolling was attempted on each specimen of refined metals, and specimens for fabrication containing above 99.7% Nb showed a Vickers hardness lower than 200. (auth)

9146 ON THE ARC REDUCTION PROCESS FOR THE PRODUCTION OF CRUDE NIOBIUM METAL. Hirozo Kimura and Yasuo Sasaki. Trans. Natl. Res. Inst. Metals (Tokyo), 5: 274-9(1963).

Crude niobium metal containing about 99% Nb was obtained from a mixture of niobium pentoxide and niobium carbide by arc reduction by the following reaction: $Nb_2O_5 + 5NbC \rightarrow 7Nb + 5CO$. Mixtures of niobium pentoxide powder and niobium carbide powder were pressed into briquettes. To proceed with the reaction at high temperature, the briquettes were arc-melted using a laboratory arc furnace with tungsten electrodes and a water-cooled copper crucible. The effects of melting time, argon pressure, and number of times of remelting on the reaction were investigated. The purity of reductants for crude niobium metal, the composition of furnace gas, and weight losses during arc-melting were examined. It was observed that a large amount of CO gas was generated from the molten specimen during arc-melting. The increase of niobium content in reductants was important because of the reaction and the vaporization of niobium monoxide, especially in low pressure melting. (auth)

9147 A BROWN ZIRCONIUM NITRIDE Zr_3N_4. R. Juza, A. Rabenau, and I. Nitschke (Christian-Albrechts-Universität, Kiel). Z. Anorg. Allgem. Chem., 332: 1-4 (Oct. 1964). (In German)

The preparation of a brown zirconium nitride, Zr_3N_4, is described. The compound showed no metallic conductivity, it was diamagnetic, and had a density of 5.9 g/cm³. (auth)

9148 THE HYDROLYSIS BEHAVIOR OF URANIUM TETRACHLORIDE IN ALKALI CHLORIDE MELTS. D. Naumann, G. Tschirne, and W. Burk (Zentralinstitut fur Kernforschung, Rossendorf, Ger.). Z. Anorg. Allgem. Chem., 332: 63-8(Oct. 1964). (In German)

The existence of uranium(IV) oxychloride as an intermediate in the hydrolysis of UCl_4 to UO_2, occurring in molten alkali chlorides because of the presence of water vapor, was proved by equilibrium investigations. (auth)

9149 SOLUBILITIES OF RARE EARTH OXALATES IN EDTA SOLUTIONS AND THE DETERMINATION OF THEIR SOLUBILITY PRODUCTS. T. R. Bhat and T. Venkateswara Rao (Atomic Energy Establishment, Trombay, India). Z. Anorg. Allgem. Chem., 332: 204-8(Oct. 1964).

The solubilities of the oxalates of Ca, La, Ce, Pr, Nd, Sm, Gd, Tb, Dy, Ho, Er, Yb, and Y in 0.1$\underline{M}$ EDTA solution at different pHs at 25 and 40°C were determined. From these data the solubility products of the oxalates at 25°C were calculated. (auth)

9150 ZIRCONIUM(III) FLUORIDE. Paul Ehrlich, Fritz Ploeger, and Ernst Koch. APPENDIX ON ATTEMPTS TO PREPARE THORIUM(III) FLUORIDE. Paul Ehrlich and Gustav Kaupa (Universität, Giessen, Ger.). Z. Anorg. Allgem. Chem., 333: 209-15(Dec. 1964). (In German)

ZrF_3 was prepared by reaction of zirconium hydride with a H_2-HF mixture at 750°C. Reduction of $(NH_4)_2ZrF_6$ with H_2 at 650°C yielded a product of inferior purity. ZrF_3 is a bluish-gray substance of great thermal stability. From the appearance of the x-ray pattern a crystal structure similar to that of TaF_3(ReO_3 type) is assumed. The compound exhibited paramagnetism nearly independent of temperature. The theoretical magnetic moment 1.73 was almost reached at 20°C. A density value of 4.26 g/cm³ was found. Attempts to prepare ThF_3 failed. (auth)

9151 THERMAL CHARACTERISTICS OF HALIDES. XVI. SATURATION PRESSURE MEASUREMENTS ON SOME METAL HALIDES ACCORDING TO THE "BELL METHOD." Werner Fischer and Thomas Petzel (Technische Hochschule, Hanover). Z. Anorg. Allgem. Chem. 333: 226-34 (Dec. 1964). (In German)

Vapor pressures in the range from 3 to 5 mm Hg to nearly 1 atm of ZrF_4, HfF_4, SnF_2, $BeCl_2$, and of $MgCl_2$

lower than 125 mm Hg only) were measured by means of the "bell method." In the case of $CaCl_2$ only approximate data could be obtained. The bell method allowed the investigation of substances that are highly corrosive to silicate materials; the substances contact metals only. (auth)

9152 ON THE SILICON AND GERMANIUM CHALCOGENIDES OF ZIRCONIUM AND HAFNIUM. Hajo Onken, Karl Vierheilig, and Harry Hahn (Universität, Würzburg, Ger. and Landwirtschaftlichen Hochschule Hohenheim, Stuttgart). Z. Anorg. Allgem. Chem., 333: 267-79(Dec. 1964). (In German)

The compounds ZrSiO, ZrSiS, ZrSiSe, ZrSiTe, HfSiS, HfSiTe, ZrGeS, ZrGeSe, ZrGeTe, HfGeS, HfGeSe, and HfGeTe were prepared and investigated. They crystallize in the PbFCl type. (auth)

9153 COMPOSITION AND THERMAL STABILITY OF LANTHANUM FORMATE. V. E. Plyushchev, L. P. Shklover, and T. A. Trushina. Zh. Neorgan. Khim., 9: 2710-14 (Dec. 1964). (In Russian)

The composition of La formate synthesized at ordinary temperatures is expressed by the formula $La(HCOO)_3 \cdot 0.2H_2O$. A complete elimination of water was achieved by isothermal drying at 230°C. Isothermal drying methods were used, and thermal and thermogravimetric analyses were made of La formate thermal stability. The mechanism of formate decomposition to lanthanum oxide was also studied. (R.V.J.)

9154 RELATIVE VOLATILITY OF $ZrCl_4$ AND $HfCl_4$ ABOVE THE MELTING POINT. L. A. Nisel'son and V. I. Stolyarov. Zh. Neorgan. Khim., 9: 2779-80(Dec. 1964). (In Russian)

The relative volatility (α) of $ZrCl_4$ and $HfCl_4$ at 450°C was determined by an equiponderant evaporation method. It is shown that $\alpha ZrCl_4/HfCl_4 = 1.70 \pm 0.01$. (R.V.J.)

9155 ON THE MECHANISM OF PRASEODYMIUM NITRATE REACTION WITH TARTARIC ACID. O. E. Zvyagintsev and V. P. Tikhonov. Zh. Neorgan. Khim., 9: 1789-91(Dec. 1964). (In Russian)

Potentiometric titration of $Pr(NO_3)_3$ solution with tartaric acid was studied. Absorption spectra of the soluble components in alkali medium were measured. A reaction mechanism is postulated from the data. (R.V.J.)

Organic Chemistry

Refer also to abstract 8952.

9156 (IS-450) CALCULATIONS ON ELECTRONIC SPECTRA OF CATACONDENSED AND PERICONDENSED AROMATIC HYDROCARBONS. Richard L. Hummel and K. Ruedenberg (Ames Lab., Ames, Iowa). Dec. 1964. Contract W-7405-eng-82. 693p. Dep.(mn); $9.93(cy), 11(mn) OTS.

Tables are presented of molecular calculations for 30 aromatic hydrocarbons. These calculations include the TBX, IRX, TBM, and IRM approximations. Eigenvalues and eigenvectors are presented together with ground state bond orders and configuration interaction calculations. (D.L.C.)

9157 (NYO-2567-1) FINAL REPORT [ON PROPERTIES OF RNA]. R. A. Brown (Wistar Inst. of Anatomy and Biology, Philadelphia). Contract AT(30-1)-2567. 4p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The physical and chemical properties of RNA were studied in an attempt to contribute to an understanding of the problem of the genetic control of protein synthesis. Studies with rat liver RNA and Ehrlich ascites tumor RNA indicated that RNA interactions may be involved in the process of differentiation that is similar to the process of carcinogenesis. The interaction of small ions and molecules with RNA was found to be specific and the binding of metallic ions was shown to inhibit or reverse the dissociation of RNA by proteins. Cellular RNA also appeared to be able to distinguish between L and D amino acids and to interact with several carcinogens. The binding of amino acids by RNA was studied and results indicated that whereas the binding of different amino acids is non-competitive the binding of derivatives of the same amino acid appears to be competitive. Attempts were made to determine the molecular weight in microgram concentrations of transfer RNA using ultracentrifuge and ultraviolet optical techniques. The molecular weight of soluble RNA obtained was lower than that reported. The sedimentation rate of soluble RNA was found to be affected by EDTA at concentrations greater than 0.01 $\underline{M}$ and these changes were reversed by the addition of ions of Zn, Mg, and Mn. With dilute solutions it was found that there is a loss of a small key piece of the RNA molecule unless molarity of Mn, Mg, and Zn was adjusted to levels slightly higher than the molarity of the soluble RNA. The molecular weight dropped from 25,000 to 11 to 14,000 if this small key piece was lost. This drop in molecular weight was found to be reversible. It was concluded that soluble RNA is held together in some cooperative fashion by the ions of Mn, Mg, and Zn. (C.H.)

9158 TAUTOMERISM IN ISOTOPICALLY SUBSTITUTED INDENES. Goeran Bergson (Uppsala Univ.). Acta Chem. Scand., 18: 2003-5(1964).

Kinetic measurements were made of tautomeric rearrangements in indene. Deuterium isotope effects were studied. Nuclear magnetic resonance spectra were measured. The primary isotope effect, K_H/K_D, was found to be 5.8. (M.C.G.)

9159 HYDROGEN EXCHANGE IN CHLOROPHYLL AND RELATED COMPOUNDS, AND CORRELATION WITH MOLECULAR ORBITAL CALCULATIONS. Ralph C. Dougherty, Harold H. Strain, and Joseph J. Katz (Argonne National Lab., Ill.). J. Am. Chem. Soc., 87: 104-9(Jan. 5, 1965).

Exchangeability of H at the C-10 and δ-methine positions in chlorophyll, bacteriochlorophyll, and some of their derivatives was compared in several solvent systems. With methanol in tetrahydrofuran and in acetone, the H situated at both positions is labile, but exchange at C-10 is at least two orders of magnitude faster than at the δ-position. With methanol in pyridine, H exchange at C-10 is very rapid, whereas exchange at all methine C atoms is very slow. Exchange at the δ-position is influenced by the presence of Mg; removal of the Mg reduces the exchange rate at the bridge positions to a very low value. The experimental observations are discussed in the light of semiempirical molecular orbital calculations based on porphin and chlorin compounds. (auth)

9160 BIOSYNTHESIS OF ^{14}C-LABELLED FLAVIN ADENINE DINUCLEOTIDE BY EREMOTHECIUM ASHBYII. Toshiharu Nagatsu, Ikuko Nagatsu-Ishibashi, and Kunio Yagi (Nagoya Univ., Japan). J. Biochem. (Tokyo), 54: 152-5(Aug. 1963).

The incorporation of ^{14}C of ^{14}C-formate into FAD and riboflavin by mycelium of the yellow strain of this organism is reported. The ^{14}C-formate (20 μC) was added to 500 ml of medium and cultivation at 30°C was carried out for 4 days under constant shaking. The mycelium was separated by filtration on a glass filter, and radioactive FAD and riboflavin were prepared from both supernatant and mycelium. Flavins in the mycelium were extracted by warm-water extraction. After the aqueous extract was combined with the supernatant and saturated with $(NH_4)_2SO_4$, the flavins were extracted with phenol. Two volumes of ethyl ether were added to the phenolic solutions and the mixture was extracted with a small amount of water. The aqueous extract was passed through a column of Florisil, which was washed consecutively with 2% acetic acid, water, and 0.5% pyridine. Flavins were eluted with 5% pyridine. The eluate was washed with chloroform and filtered; then the filtrate was concentrated under reduced pressure and redissolved in a small amount of water. From this aqueous solution, FAD and riboflavin were separated by large scale paper chromatography using $\underline{n}$-butanol/acetic acid/water (4 : 1 : 5, v/v/v/) as solvent. Quantities of the flavins were estimated by their absorption at 445 mμ. The results of a degradation procedure showed that ^{14}C of ^{14}C-formate was incorporated into only C2 of the isoalloxazine nucleus of riboflavin synthesized by E. ashbyii. It was concluded that two-thirds of the radioactivity of FAD must be attributed to adenine part, namely, to the carbons 2 and 8 of adenine. (BBB)

9161 t-BUTYL HYPOCHLORITE CHLORINATIONS OF HYDROCARBONS. THE ROLE OF CHLORINATED SOLVENTS. Andreas A. Zavitsas (Brookhaven National Lab., Upton, N. Y.). J. Org. Chem., 29: 3086(1964). (BNL-8054)

The role of CCl$_4$ in t-butyl hypochlorite chlorinations of hydrocarbons was investigated. Results indicate that in the usual t-butyl hypochlorite chlorinations in CCl$_4$, the solvent is not involved in the chain reaction sequence. Studies concerning activation energies of reactions of alkyl radicals derived from or in the presence of hypochlorites can be carried out in CCl$_4$ without any doubt as to the origin of the Cl atom in the alkyl halide product. (J.R.D.)

9162 INACTIVATION OF CHYMOTRYPSIN IN AQUEOUS SOLUTION BY ATOMIC HYDROGEN. Lrna K. Mee (Cambridge Univ., Eng.). Nature, 204: 1056-7(Dec. 12, 1964).

The effects of H atoms on chymotrypsin were investigated by examining the kinetic parameters of the enzyme through spectroscopic changes. Changes in the absorption spectrum of chymotrypsin support the conclusion of a selective attack by H atoms. The observed selectivity may be accounted for by specific reductive processes mediated by radicals. (J.R.D.)

Radiation Chemistry

Refer also to abstract 9777.

9163 (AERE-R-4737) LIGHT-INDUCED CHEMILUMINESCENCE. T. J. Kemp and C. G. Clayton (United Kingdom Atomic Energy Authority. Research Group. Wantage Research Lab., Wantage, Berks, England). Sept. 1964. 30p. Dep.; $1.00(BIS); 5s.(HMSO).

The hypothesis that spurious luminescence in dioxan-based liquid scintillators arises from photochemically induced decomposition of peroxidic impurities has been examined by observing other organic liquids containing peroxide impurities, solutions of hydroperoxides, and solutions of unstable azo-compounds. The results indicate that all these systems show very similar behavior with regard to the intensity, duration, and mode of decay of the luminescence and that the effect of oxygen increases the period of luminescence in all cases. By studying the photoinduced decomposition of azo-bis-isobutyronitrile in benzene under conditions of nitrogen saturation, it is concluded that in this type of process the oxygen molecule cannot be considered to be associated with the fluorescence mechanism as in the case of thermally decomposing hydroperoxides. It is suggested that the observed luminescence may be related to that which occurs in several other processes such as the electrolysis of amino- and carboxylic acids and the dissolution of x-irradiated organic and inorganic compounds. (auth)

9164 (CONF-641109-1) GRAFT COPOLYMERIZATION. Report No. 133-64-07. W. A. Cramer (Reactor Instituut, Delft, Netherlands). Nov. 1964. 21p. Dep.(mn).

From International Congress on Application of Large Radiation Sources in Industry, Amsterdam.

Various methods which can be used for the radiation-induced formation of graft copolymers are described. Several examples of the modification of fibrous materials, cellulose, and rubber, using irradiation techniques, are given. The use of polyfunctional monomers to improve the yield of crosslinks in irradiated polymers is also mentioned. Finally, economic aspects of the irradiation processes are considered, and it is concluded that radiation-produced graft copolymers may be expected to become commercially important in the near future. (auth)

9165 (COO-32-105) CHEMICAL EFFECTS OF NUCLEAR TRANSFORMATIONS OF HALOGENS IN ORGANIC MEDIA. John E. Willard (Wisconsin. Univ., Madison). [1964]. Contract AT(11-1)-32. 23p. (CONF-773-7)

From Symposium on Chemical Effects Associated with Nuclear Reactions and Radioactive Transformation, Vienna, Dec. 1964. Dep.(mn); $1.00(cy), 1(mn) OTS

A review is presented of investigations in 1960 to 1964 on nuclear transformations of halogens in organic media. Gaseous, liquid, and solid phase reactions are covered. Isotope effects are also considered. (D.L.C.)

9166 (COO-32-106) EVIDENCE OF PRODUCTION OF NEUTRAL S^{35} ATOMS BY THE Cl^{35}(n,p)S^{35} PROCESS IN ALKALI METAL CHLORIDES. R. C. Milham, A. Adams, and J. E. Willard (Wisconsin. Univ., Madison) [1964]. Contract AT(11-1)-32. 24p. (CONF-773-8). Dep.(mn); $2.00(cy), 1(mn) OTS.

From Symposium on Chemical Effects Associated with Nuclear Reactions and Radioactive Transformations, Vienna, Dec. 1964.

Experiments are described in which vacuum-sublimed KCl, RbCl, NaCl, and CsCl were irradiated in reactors and then dissolved either in air-free NaOH solution containing sulfide, sulfite, and sulfate carriers, or in NaOH solution followed by addition of carriers. The results show that the irradiated crystals contained 25 to 50% of its ^{35}S as a species which was recovered as sulfide in carrier solution but which appeared as sulfite and sulfate when carriers were added after the dissolution. A study was made of the yield of this species in KCl as a function of carrier concentrations, and it concluded that both sulfide and sulfite carriers are able to protect the species from oxidation by water. The effects of gamma irradiation before or after neutron irradiation and of thermal annealing on the yield of the species in KCl were also studied. Arguments are given for the hypothesis that this species is monoatomic neutral sulfur. The role of defects in the mechanism is discussed. (D.L.C.)

9167 (GNE/PHYS/64-2) RADIOLYSIS OF PROPANE AT LOW CONVERSION (thesis). Norman Keith Blocker (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1964. 66p. (AD-603605). $3.00(OTS).

Low conversion studies of the radiolysis of propane were performed by the use of a technique which was developed to satisfy the stringent requirements of purity and trace analysis capability. The calculated G value for ethane in the low conversion region was 1.95. All other product yields were determined relative to this value. Significant increases in yields for propylene and ethylene were observed as the degree of conversion was decreased from 2.6 to 0.0045 per cent. These increases were attributed to the absence of internal scavenging reactions involving hydrogen atom attack on these products. A decrease in the yield of 2,3-dimethylbutane was accompanied by an increase in the yields of methane and ethane as the conversion was increased from 0.05 to 1.00 per cent. It was concluded that the initial yields for the radiolysis products were represented by the product yields at the lowest degree of conversion. (auth)

9168 (JINR-E-1851) THE CHEMICAL STATES OF RADIOIODINE FORMED BY 660 Mev PROTON IRRADIATION OF CAESIUM CHLORIDE CRYSTALS. J. Dema and N. G. Zaitseva (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 17p. Dep.(mn).

It is shown that the irradiation dose and subsequent thermal annealing affect the chemical forms of radioiodine obtained by 660 Mev-proton irradiation of cesium chloride and cesium nitrate crystals. On the basis of kinetical investigations of the fast thermal annealing process, the rate of radioiodine transition from a higher oxidation state to a lower one was calculated, as well as the corresponding activation energy of the reduction process and the order of reaction. It is suggested that in the fate of radioiodine recoils, the mechanisms involving the interactions between radioiodine fragments and lattice defects of the irradiated crystals are of great importance. (auth)

9169 (NYO-2915-1) HYDROCARBON REACTIONS FROM FISSION-FRAGMENT IRRADIATION. Final Report. Wallis A. Lloyd (Pennsylvania State Univ., University Park. Coll. of Engineering). Nov. 15, 1964. Contract AT(30-1)-2915. 12p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Fission-fragment irradiation of methane produced an abundance of hydrogen, significant amounts of ethane and propane, and traces of higher saturated hydrocarbons. Unsaturated hydrocarbons (ethylene and propylene) were present in very small concentration in the irradiated mixture, but more so than in gamma irradiation of methane. The larger amounts of unsaturates found with fission fragments was a consequence of the much higher dose rate. As with methane irradiation, there was little difference in the results obtained when hydrocarbon–oxygen mixtures were exposed to gamma and fission-fragment irradiation. Oxygenated hydrocarbons produced in significant quantities included: methanol from methane–oxygen mixtures; methanol, ethanol, and acetaldehyde from ethane–oxygen mixtures; isopropanol, acetone, and acetaldehyde from propane–oxygen mixtures; and acetaldehyde, ethanol, and isopropanol from ethylene–oxygen mixtures. (N.W.R.)

9170 (TID-21232) PULSE RADIOLYSIS OF AQUEOUS H_2 SOLUTIONS: 1. RATE CONSTANTS FOR REACTION OF e^-_{aq} WITH ITSELF AND OTHER TRANSIENTS. 2. THE INTERCONVERTIBILITY OF e^-_{aq} AND H^1. Max S. Matheson and Joseph Rabani (Argonne National Lab., Ill.). [1964]. Contract [W-31-109-eng-38]. 45p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The technique of pulse radiolysis was applied to aqueous solutions with (up to 100 atm) and without dissolved H_2 in the pH range 7-14. This work demonstrated the reaction $H + OH^-_{aq} \rightarrow e^-_{aq}$, by direct observation of the absorption of the e^-_{aq} formed as a product. The rate constants for this and several other reactions in this system were determined. The values obtained are: $k(H + OH^-_{aq}) = 1.8 \pm 0.6 \times 10^7$; $2k(e^-_{aq} + e^-_{aq}) = 1.1 \pm 0.15 \times 10^{10}$ at pH 13.3; $k(e^-_{aq} + O^-_{aq}) = 2.2 \pm 0.6 \times 10^{10}$ at pH 13; $k(O^-_{aq} + H_2) = 8 \pm 4 \times 10^7$; $k(e^-_{aq} + H) = 2.5 \pm 0.6 \times 10^{10}$; $k(e^-_{aq} + OH) = 3.0 \pm 0.7 \times 10^{10}$ $\underline{M}^{-1}$ sec^{-1}. (auth)

9171 (JPRS-27372(p.5-11)) 1. MEASUREMENT OF PEAK OF LUMINESCENCE AND ENERGY OF ACTIVITY OF RADIATION-EXPOSED POLYETHYLENE. 2. THERMOLUMINESCENCE OF RADIATED POLYMERS. Wen-hsiang Yang, Kuan-ying Ch'ien, Kuang'tz'u Lai, and Pao-kung Ch'ien. Translated from K'o Hsueh T'ung Pao, No. 8, 707-9(1964).

The thermoluminescence spectra of polythene are measured as functions of temperature and temperature rate-of-change, following exposure of the polythene to ^{60}Co gamma radiation at 77°K. In order to correlate the thermoluminescence peaks with structural changes in polythene, differential thermal analysis is employed. (T.F.H.)

9172 KINETICS OF SULFOCHLORINATION OF CYCLOHEXANE IN CARBON TETRACHLORIDE INDUCED BY GAMMA RADIATION. Alfred Schneider and Ju Chin Chu (Polytechnic Inst. of Brooklyn). A.I.Ch.E. (Am. Inst. Chem. Engrs.) J., 10: 930-4(Nov. 1964).

Solutions of cyclohexane, chlorine, and sulfur dioxide in carbon tetrachloride were irradiated in an oxygen-free system with gamma rays from uranium fission products contained in spent fuel elements. Reaction rates, equivalent to the rate of disappearance of free chlorine, were determined spectrophotometrically at 4,000A. The reaction products were cyclohexanesulfonyl chloride and hydrochloric acid in nearly stoichiometric quantities. An empirical rate equation was derived, in which the rate of disappearance of chlorine was shown to be proportional to the square root of the product of absorbed radiation, chlorine and cyclohexane concentrations, and independent of the concentration of sulfur dioxide. A chain mechanism was proposed, and the rate equation derived from this scheme was found to be in excellent agreement with the empirical rate equation. The reaction proceeded by a free radical mechanism, as evidenced by the strong inhibiting effect of oxygen. G numbers were of the order of 10^5, corresponding to an estimated chain length of 5,000, which is of the same order as the quantum yield of the photochemical sulfochlorination. (auth)

9173 ON THE INFLUENCE OF HALOGENE-ADMIXTURE VAPOURS ON INDUCED ELECTRON EMISSION (EXOELECTRON EMISSION) INTO A GASEOUS ATMOSPHERE. B. Sujak (Wroclaw Univ., Poland) and I. Bójko. Acta Phys. Polon., 26: 171-4(Aug. 1964).

Studies were made of the photostimulated excited emission of electrons from surfaces of pure Al and of Al oxide, in a counter atmosphere of pure Ar mixed with a quenching vapor. A G–M counter was used for electron detection. Quenching gases of I_2, Br_2, $C_2H_4Br_2$, C_2H_5I, $CHCl_3$, $CHBr_3$, CH_3I, and $SnCl_4$, with ethyl alcohol vapor added if necessary for satisfactory counter performance, were considered. It was found that, in electronegative gases, an effect of a counting-yield change can be superimposed upon the effect of the excited electron emission intensity variation because of changes in the composition of the gas in which the emission occurs, if the sample is not separated mechanically from the counter atmosphere. (M.J.T.)

9174 CERTAIN CHARACTERISTICS OF RADIOLYSIS WITH FAST ELECTRON PULSED BEAM. V. L. Tal'roze and V. E. Skurat. At. Energ. (USSR), 17: 393-400(Nov. 1964). (In Russian)

The basic characteristics of radiolysis using pulsed accelerated electrons are studied. The dependence of the average stationary concentration of free radicals $[R]_{st}$ on the reciprocal of the pulse duty factor q of the electron current pulses is calculated on the basis of the typical mechanism of chemical reactions of free radicals formed during the action of the pulsed beam of fast electrons. The calculation was carried out for various powers, corresponding to different rates of free-radical formation, for various times of duration of the current pulses, and for various free-radical decomposition constants according to first- and second-order reactions. Graphs of the dependence of $[R]_{st}$ on q are presented. (tr-auth)

9175 THE PLACE OF RADIATION IN PRODUCTION OF CHEMICALS. John F. Kircher and David A. Jeffrey. Battelle Tech. Rev., 14: No. 1, 3-9(Jan. 1965).

Uses of radiation in chemical production are reviewed. Research on radioinduced reactions is discussed along with important factors in the use of radiation. Included are sections on radiation sources, organic chemical production, polymerization, and cost factors. (J.R.D.)

9176 INFLUENCE OF CYSTEINE ON THE PHOTOCHEMICAL DECOMPOSITION OF THYMIDYL-(5′-3′)-BROMODEOXYURIDINE. A. Haug (Universität, Cologne). Biochim. Biophys. Acta, 88: 480-6(Nov. 29, 1964).

Irradiating a solution of thymidyl-(5′-3′)-bromodeoxyuridine with monochromatic, ultraviolet light yields one main photo-product, an intramolecular dimer, containing no Br and a cyclobutene ring structure. In the presence of cysteine and ultraviolet radiation the dimer is further decomposed to a photo-product characterized by an end-absorption spectrum. This compound contains one S atom per dinucleotide and cannot be reverted by irradiation at 2400 Å. The quantum yields of this sulfhydryl addition were measured as a function of wavelength. The reaction kinetics and the biological implications of this process, which is possibly radioprotective, are discussed. (auth)

9177 POST-IRRADIATION CHANGES IN SOLUTIONS OF HYALURONIC ACID EXPOSED TO X-RAYS. H. B. Lamberts (State Univ., Groningen, Netherlands) and P. Alexander. Biochim. Biophys. Acta, 88: 642-4(Nov. 29, 1964).

The post-irradiation effect in hyaluronic acid, the polysaccharide moiety of synovial fluid, was studied. It was found that if irradiation is carried out in a solution containing 0.1$\underline{M}$ NaCl the fall in viscosity following exposure to 2000 R is largely a post-irradiation phenomenon, the rate of which depends upon the temperature of the solution. On the other hand if the hyaluronic acid is irradiated in solutions that contain either no added electrolyte or 0.1$\underline{M}$ NaF, or 0.1$\underline{M}$ $NaClO_4$ no significant post-irradiation effect is observed and the fall in viscosity is essentially complete by the time the first determination has been made. The decrease in viscosity is attributed to main-chain scission. (P.C.H.)

9178 THE ADDITION REACTIONS OF PROPANOL-2 TO ETHYLENE INDUCED BY GAMMA-RAY IRRADIATION IN THE GASEOUS PHASE. Tadashi Kurihara and Hiroshi Hotta (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 37: 1448-53(Oct. 1964).

When a mixture of propanol-2 and ethylene was irradiated in the gaseous phase by ^{60}Co gamma rays at 100 to 200°C, thirty-seven products were found by gas chromatography from the samples above 150°C in addition to the telomers already reported, and fifteen products were found at 100°C. While the yield of these products increased with increasing temperature, the yield of the telomers increased not only with an increase in temperature but also with a decrease in temperature below 125°C. The identified products showed that all the radicals expected from propanol-2 were present as the precursors of these products. It was concluded from these facts that the various radical transfer reactions and disproportionation reactions occur in the gaseous phase, especially above 150°C, although the addition reactions are predominant in the liquid phase at lower temperatures. Although 1-hydroxyethyl radical ions were predominant in the electron impact reactions of propanol-2, the 1-hydroxyisopropyl radical was predominant among the precursor radicals. This showed that the processes considered are radical and not ionic. (auth)

9179 RADIATION-INDUCED SELECTIVE MAIN-CHAIN SCISSION IN POLYVINYL ALCOHOL. Yutaka Hirano (Tokyo Univ.). Bull. Chem. Soc. Japan, 37: 1495-1500(Oct. 1964).

Polyvinyl alcohols, which are different in the mole fraction of the head-to-head structure, in which two of –OH substituents are situated on consecutive carbon atoms, were irradiated with ^{60}Co gamma rays in a vacuum at room temperature in order to investigate the effect of this anomalous structure on the radioinduced main-chain scission of the polymer. The selective main-chain scission in polyvinyl alcohol was observed at such positions as the head-to-head structure. The average absorbed energy necessary to produce a main-chain scission, E_d, was about 1700 ev for polyvinyl alcohol containing no head-to-head structure and 100 ev for polyvinyl alcohol containing a 1.54 mol % head-to-head structure. A rapid increase up to a certain value in G_d, the number of chain scissions produced per 100 ev of energy absorbed by the polymer, was observed with the increase in the head-to-head structure content in the polymer chain. Thus, it was postulated that there is a transfer of radiation energy from the head-to-tail structure to the head-to-head structure. An estimation was made of the range of energy transfer from G_d dependency on the concentration of the head-to-head structure. (auth)

9180 THE EFFECT OF MAGNETIC FIELD ON THE RADIATION-INDUCED POLYMERIZATION OF FORMALDEHYDE IN THE SOLID STATE AT A LOW TEMPERATURE. Yoneho Tabata, Harutaka Kimura, Hiroshi Sobue, and Keichi Oshima (Tokyo Univ.). Bull. Chem. Soc. Japan, 37: 1713-15(Nov. 1964).

The relation between polymerization yield for formaldehyde and irradiation time using a gamma source for various magnitudes of the magnetic fields at 196°C was determined. The rate of polymerization increased with the magnitude of the magnetic field and the saturation value of the yield also increased. At –130°C, however, the polymerization yield was not affected by the magnetic field. (M.C.G.)

9181 THE ELECTRON SPIN RESONANCE OF SODIUM POLYPHOSPHATE LABELED WITH ^{32}P. Masaji Miura and Akinori Hasegawa (Hiroshima Univ.). Bull. Chem. Soc. Japan, 37: 1715(Nov. 1964).

It was found that sodium polyphosphate labeled with ^{32}P(SPP*) becomes red on standing but that the color fades away when it is heated to 200°C. This substance was also studied by means of an electron spin resonance (ESR) technique and it was found that the absorption bands of ESR are closely related with the red color of SPP*. It was concluded that SPP* as well as irradiated SPP has two absorption bands, which may be the hyperfine structure arising from the interaction of a trapped electron with a phosphorus nucleus. (M.C.G.)

9182 ADDITION REACTIONS INITIATED BY HIGH-ENERGY RADIATION. Guy Rabilloud. Compt. Rend., 259: 3009-10(Nov. 2, 1964). (In French)

Under the effect of high energy electromagnetic radiation, some organic compounds are capable of adding on at the double bond of an ethylenic hydrocarbon. These results indicated a process for the synthesis of numerous organic compounds. The addition reactions of alcohols, amines, aldehydes, thiols, and alkylphosphites were studied, among others. (tr-auth)

9183 EFFECT OF THE DIFFUSION IN THE RADIATION-INDUCED GRAFT COPOLYMERIZATION OF STYRENE ON TEFLON. Hiroshi Matsuo and Mamoru Kondo (Nippon Telegraph and Telephone Public Corp., Tokyo). Denki Tsushin Kenkyusho Kenkyu Jitsuyoka Hokoku, 13: 517-29(Apr. 1964). (In Japanese)

Teflon films of different thicknesses were immersed in styrene monomer and irradiated with γ rays in vacuo. The dose rate was 10^4 to 10^5 r/hr and the total irradiation time was 8 to 18 hours with intermittences in some cases. The irradiation temperature was 50°C. The resulting graft copolymerization of styrene on Teflon was considerably diffusion-controlled because of the very poor tendency of Teflon to swell with the monomer. The distribution of the concentration of graft copolymer was examined by taking interference microphotographs of the thin sections of the grafted Teflon films. The concentration of the graft copolymer was calculated from the interference fringes. First the monomer is grafted on the surface of Teflon film and the diffusibility of the monomer into the film increases in that portion. Therefore the grafting reaction is accelerated with a sudden rise of 45% of graft copolymer concentration and the distribution of the concentration becomes more and more uniform. It is shown that the dose rate and other irradiation conditions have great influence on the velocity and uniformity of the grafting reaction. For example, irradiation at low dose rate, intermittent irradiation, and dilution of the monomer with a solvent were favorable for the reaction by increasing the apparent diffusion velocity relative to the velocity of polymerization reaction. (NSA of Japan)

9184 RADIOLYSIS OF AQUEOUS POTASSIUM CYANIDE SOLUTION BY Co-60 GAMMA IRRADIATION. Akira Yakohata and Satoru Tsuda (Hiroshima Univ.). Doitai To Hoshasen, 4: 393-5(Dec. 1961). (In Japanese)

The decomposition of aqueous KCN solution by γ irradiation at a dose rate of 1.59×10^5 r/hr was investigated. In air-saturated KCN solutions of different concentrations, the decomposition of cyanide by irradiation for 60 to 80 min differed considerably according to the concentration; the higher the concentration, the greater was the decomposition. The decomposition was also influenced by the presence of oxygen. The formation of ammonia in the radiolysis of KCN was observed. When oxygen was present, ammonia formation is slow at the beginning of irradiation, but after 120 to 140 min the reaction proceeded rapidly. (NSA of Japan)

9185 LUMINESCENCE OF ARGON MIXED WITH MOLECULAR GASES UNDER THE INFLUENCE OF IONIZING RADIATION IN AN ELECTRIC FIELD. Aleksander Szymanski and Jan A. Herman (Université Laval, Quebec). J. Chim. Phys., 61: 1307-12(Sept. 1964). (In French)

The light between 3200 and 5000 Å of mixtures of Ar and molecular gases ionized by α particles from ^{210}Po was studied in an electric field. The intensity of the light emitted depended on the square of the ratio P/X. The addition of an electronegative gas, such as oxygen, modified the shape of the phenomena observed relatively to a non-electronegative gas. (tr-auth)

9186 FLUORESCENT PROPERTIES OF RED-EMITTING EUROPIUM-ACTIVATED PHOSPHORS WITH CATHODE RAY EXCITATION. A. Bril, W. L. Wanmaker, and C. D. J. C. de Laat (Philips' Gloeilampenfabrieken, N. V., Eindhoven, Netherlands). J. Electrochem. Soc., 112: 111-12 (Jan. 1965).

It is noted that the factors which together determine the lumen contributions for each primary phosphor are radiant efficiency, the lumen equivalent, and the weight factor of the lumen. Various phosphors are discussed and the spectral and radiant properties of Eu-activated gadolinium and yttrium oxides are examined. (J.R.D.)

9187 THE RADIATION INDUCED COPOLYMERIZATION OF FORMALDEHYDE AND STYRENE. Y. P. Castille and V. Stannett (Camille Dreyfus Lab., Research Triangle Inst., Durham, N. C.). J. Polymer Sci., Pt. B, 2: 1097-1100(Dec. 1964).

The gamma irradiation of various proportions of formaldehyde and styrene in dry ice leads to the formation of hard and brittle polymers. The mixtures of both monomers containing less than 70% of formaldehyde consisted of a paste of styrene crystals in a saturated solution of styrene in formaldehyde. At higher ratios of formaldehyde, the monomer mixture remains liquid. The fact that the rate of conversion is much faster for formaldehyde compared with styrene suggests that the copolymer could be a graft copolymer, resulting from grafting of styrene monomers to the already formed polyoxymethylene. The incorporation of styrene groups in the polyoxymethylene chains causes an improvement in the thermal stability of the polyoxymethylene. (N.W.R.)

9188 TEMPERATURE DEPENDENCY OF CROSSLINKING RATE OF POLYMERS DURING GAMMA IRRADIATION. Robert K. Jenkins (Northrop Space Labs., Hawthorne, Calif.). J. Polymer Sci., Pt. B, 2: 1147-54 (Dec. 1964).

The effects of temperature on the change of modulus with radiative exposure of two filled, vulcanized elastomers were investigated. Deviations from the Arrhenius plot of log G(c.l.) versus 1/T for the RTV-11 polymer were observed, in contrast to data reported for linear, amorphous, unfilled elastomers. The irradiations were performed using a 5000-C cobalt-60 source in air at 100 to 325°F. The crosslink yield for the RTV-11 polymer was determined by employing equations derived from the kinetic theory of elasticity. The Hypalon-40 is a partially chlorosulfonated polyethylene and RTV-11 is essentially polydimethylsiloxane and filler. The rate of change of modulus of the polymer with time when exposed to both gamma radiation and a temperature of 325°F is less than when the polymer is exposed to only the temperature environment. Again, as with the RTV-11 polymer, the influence of the filler adds an uncertainty in the analysis of the results. (N.W.R.)

9189 RADIATION-INDUCED TELOMERIZATION. Kozo Hirota and Motoyoshi Hatada (Osaka Univ. and Nippon Hoshasen Kobunshi Kenkyukyokai-Osaka Lab.). Kagaku To Kogyo (Tokyo), 16: 777-86(1962). (In Japanese)

Most studies on telomerization, or the chain reaction forming telomer in the form of XM_nY, where X and Y are called telogen and M taxogen, report the use of a third substance as a source of radicals, and the use of thermal, photochemical, or uv irradiation methods for initiating the reaction. For the last three to four years, application of nuclear radiation for the process has been increasingly reported. Advantages of radioinduced reactions are discussed theoretically with reference to examples, using data from previous studies. Tables of G values (no. of molecules reacted/100 ev radiation absorbed) are included for many olefins and their derivatives along with tables of activation energy and chain-transfer constants. The theoretical discussion of the telomerization mechanism, comparing previous and radiation methods, deals with the relations of G values to radiation doses in radical formation, k_p/k_t relations in determining activation energy, determination of the chain-transfer constant, the role of by-product ions, and the importance of G values in industrial applications. No conclusion was drawn as to the relative advantage of the radiation method over the previous methods using catalysis. (BBB)

9190 SOME ASPECTS OF THE TECHNOLOGICAL SYSTEM FOR MAKING TECHNICAL RUBBER PRODUCTS BY THE METHOD OF RADIATION VULCANIZATION. E. N. Smagin, M. V. Zueva, F. A. Makhlis, and A. S. Kuzminskii. Kauchuk i Rezina, No. 6, 14-16(1964).

A promising variation of the system for making rubber products by radiation vulcanization is to use a flat ^{60}Co gamma source. This technique is discussed in general terms and preliminary data on the capacity of the irradiator for molds of various materials (Fe and Al) and dimensions are tabulated. The advantages of the new device over those used previously are discussed. Radiation vulcanates based on rubbers for special purposes (dimethylsiloxane, fluororubbers, butadiene-nitrile, etc.) have a higher thermal stability than the chemical vulcanates, but a lower strength. Since no vulcanizing agents or catalysts and no other ingredient are added for radiation vulcanization, the consumption of raw material is reduced and the preparation of the mixtures is simplified. Molding is carried out at 100 to 200°C (depending on the type of rubber) for 5 to 10 min., with subsequent cooling under pressure to remove the expansion stresses. The calculation of the irradiation dose in the mold is discussed, and it is concluded that special molds must be developed for radiation vulcanization to increase the capacity of the irradiator. (auth)

9191 CHEMORHEOLOGY OF ETHYLENE-PROPYLENE COPOLYMERS. I. CHEMICAL STRESS RELAXATION OF RADIATION-CURED ETHYLENE-PROPYLENE COPOLYMERS. Hiroshi Sobue (Seikei Univ., Japan) and Kenkichi Murakami. Kobunshi Kagaku, 21: 602-5(Oct. 1964). (In Japanese)

In order to investigate the oxidation reaction at high temperatures of radiation-cured ethylene-propylene copolymers, chemical stress relaxation measurements were made. It was found that this type of elastomer was scissioned at the cross-link site preferably, in contrast with radiation-cured natural rubber, which was usually scissioned within the molecular chain randomly. From the intermittent stress relaxation measurements, it was observed that the amounts of cross-linking by oxidation decreased with an increase of the initial cross-link density. (auth)

9192 GAS-PHASE GRAFTING OF VINYL CHLORIDE TO POLYETHYLENE BY γ-RAY IRRADIATION. Masao Kadonaga and Kazuo Ueda (Nippon Telegraph and Telephone Public Corp., Tokyo). Kubunshi Kagaku, 21: 657-65(Oct. 1964). (In Japanese)

The graft copolymerization of vinyl chloride on high- and low-density polyethylenes was achieved by irradiation of the polymers in the monomer vapor. Even at high degrees of grafting, this method produced very little homopolymer. Effects of several parameters, such as dose rate (0.1×10^5 to 2.7×10^5 r/hr), vapor pressure of the monomer (282 to 2110 mmHg), reaction temperature (0 to 60°C), and film thickness (0.02 to 0.6 mm), on the kinetics of the reaction were studied. The influence of dose rate on the rate of grafting can be expressed by the empirical equation $V \propto I^{\alpha}$, in which α has a value of 0.8 to 0.9 in the range of dose rate between 1×10^4 and 1×10^5 r/hr. The relation between vapor pressure of the monomer and the rate of grafting can be expressed by the equation $V \propto P^{\beta}$, in which β has a value of 1.5 to 1.8 depending on the crystallinity of polyethylene and the thickness of the film. The initial rate of grafting decreased with an increase of temperature. Since the grafting occurred favorably in the amorphous region, the rate of grafting of low density polyethylene was higher than that of high density polyethylene. The distribution of graft concentration across the section was also discussed. (auth)

9193 RADIATION-INDUCED POLYMERIZATION OF CYCLOPENTADIENE IN THE PRESENCE OF METHYLENEDICHLORIDE. Masatoshi Miura (Hitachi Ltd., Tokyo) and Morihisa Maruko. Kogyo Kagaku Zasshi, 67: 1077-81(July 1964).

The radioinduced polymerization of cyclopentadiene in the presence of methylenedichloride at low temperature was investigated. The overall polymerization rate was proportional to the dose rate and square of the monomer concentration, and the molecular weight of the polymer obtained was independent of the dose rate. The overall activation energy had a negative value (−2.4 kcal/mol) in the temperature range from −78 to 0°C. Methylenedichloride accelerated the polymerization remarkably. Cyclopentadiene copolymerized easily with styrene, giving $r_1 = 5.3$ for cyclopentadiene and $r_2 = 1.4$ for styrene. These facts suggested that the γ induced polymerization of cyclopentadiene proceeds with a cationic mechanism. Addition of DPPH reduced the polymer yield. But the activation energy in the presence of DPPH was almost equal to that in the absence of DPPH, so this retardation may not be attributable to the coexistence of free radical polymerization. (auth)

9194 RADIATION-INDUCED AUTOXIDATION OF PHOSPHOROUS(III), ARSENIC(III) AND ANTIMONY(III) IN AQUEOUS SOLUTION. Niro Matsuura (Tokyo Univ.) and Masao Takizawa. Kogyo Kagaku Zasshi, 67: 1179-86(Aug. 1964).

Oxidation rates of S(III), where S = P, As, and Sb, induced by γ irradiation or hydrogen peroxide were enhanced by the presence of ferrous iron and oxygen. The oxidation yields of S(V) and Fe(III) depended markedly on the ratio of [Fe(II)]/[S(III)] and the acid concentration, and an increase of the ratio or the acid concentration generally decreased these yields. The effects of chloride ion concentration on the yields were also investigated. A mechanism for the autoxidation is proposed, assuming a propagation reaction between an intermediate S(IV) · O_2 and Fe(II). The intermediate S(IV), produced by the reaction between S(III) and OH radicals, reacted with oxygen and ferrous iron to yield S(V), ferric iron, and hydrogen peroxide. Thus a reaction chain was formed as the peroxide reacted with ferrous iron to yield OH radicals. The experimental results are discussed quantitatively using the parameters α and β defined as the ratio of rates $V_{S(III)\text{-}OH}/(V_{Fe(II)\text{-}OH} + V_{S(III)\text{-}OH})$ and $V_p/(V_p + V_{S(III)\text{-}OH})$ respectively, in which V_p is the rate of the propagation reaction. (auth)

9195 RADIATION-INDUCED POLYMERIZATION OF METHYL VINYL KETONE. Yoshihiko Gota (Jonan High School, Kyoto) and Yoneho Tabata. Kogyo Kagaku Zasshi, 67: 1276-8(Aug. 1964). (In Japanese)

Radioinduced polymerization of methyl vinyl ketone was investigated in bulk in a temperature region of from 22 to −78°C. It was found that the activation energy of the polymerization is 4.8 kcal/mol and that the rate of polymerization is approximately proportional to the dose rate. The polymerization was inhibited by radical scavengers. It was concluded from these results that the polymerization proceeds by a radical mechanism and the termination reaction is a unimolecular type. (auth)

9196 RADIATION-INDUCED POLYMERIZATION OF ISOPRENE. Yoneho Tabata (Tokyo Univ.) and Yoshihiko Goto. Kogyo Kagaku Zasshi, 67: 1279-81(Aug. 1964). (In Japanese)

Radioinduced polymerization of isoprene was investigated in the temperature region from 20 to −196°C. It was found that the polymerization can take place in both liquid and solid phases and the activation energy for the polymerization was 1.3 kcal/mol in the temperature region from 20 to −30°C, −0.8 kcal/mol in the temperature region from −30 to −150°C in the liquid state of the monomer, and 0.2 kcal/mol below the melting point in the solid state of the monomer. It was indicated that the polymerization proceeds by a radical mechanism at higher temperatures and by an ionic mechanism at relatively low temperatures in the liquid phase. On the other hand, it was also considered that the mechanism of the solid state polymerization at extremely low temperatures is nonradical and non-ionic in an ordinary sense. The mechanism could be explained by assuming collective excitation of the monomer crystal, as a kind of cooperative phenomena. (auth)

9197 RADIATION-INDUCED GRAFT REACTION OF ORGANOSILICON OIL ONTO COTTON CLOTH. Harumiti Shimizu and Yoshiharu Shinozaki (Tokyo Metropolitan Isotope Center). Kogyo Kagaku Zasshi, 67: 1281-4(Aug. 1964). (In Japanese)

Radioinduced grafting of organosilicon oil onto cotton cloth was investigated with ^{60}Co γ rays and Van de Graaff electron beams. Irradiation was carried out chiefly in air, but in some runs it was carried out in N_2, CO_2, or NH_3. The effects of solvents were also examined. Two kinds of organosilicon oil, linear methylhydrogenpolysiloxane (Si−H) and linear dimethypolysiloxane ($Si-CH_3$) were used. The rate of grafting in Si−H systems was greater than that in $Si-CH_3$ systems. Grafting in the $Si-CH_3$ system seemed to proceed through a peroxide mechanism, and grafting in the Si−H system proceeded through a peroxide and a free radical mechanism. Samples irradiated to about 10^6 r and postheated showed about 4% grafting, and showed good waterproof properties. (auth)

9198 POLYMERIZATION OF ISOPRENE CATALYZED BY MIXED CATALYST OF TRIETHYLALUMINUM WITH PRE-IRRADIATED TITANIUM TETRACHLORIDE. Akio Mitsutani (Kurashiki Rayon Co., Ltd., Japan) and Yoshito Hamamoto. Kogyo Kagaku Zasshi, 67: 1453-7 (Sept. 1964). (In Japanese)

Isoprene was polymerized with catalysts prepared by the reaction of preirradiated $TiCl_4$ with triethylaluminum. It was known that polymerization of isoprene with a Ziegler catalyst of Al/Ti > 1.0 yields a rubbery polymer. However it was found that a rubbery polymer can be obtained even with the catalysts of Al/Ti < 1.0, when $TiCl_4$ solution was preirradiated with γ rays from a ^{60}Co source. For example, by use of $TiCl_4$ preirradiated with a 10^5 R γ dose, rubbery polymer was obtained with a catalyst of Al/Ti > 0.66. Brown precipitate and Ti^{3+}, produced by irradiation of $TiCl_4$ solution, increased, linearly with dosage. The G-values of Ti^{+3} formation and of precipitate formation were 2.67×10^{-5} and 2.5×10^{-2} respectively. The composition of the precipitate was calculated as $TiCl_{3.84}$, or approximately $TiCl_4$. From these results it was concluded that the cause of shift in transition composition of the stereospecificity of $TiCl_4$ solution is not $TiCl_3$ formation from $TiCl_4$ by irradiation. (auth)

9199 RADIATION POLYMERIZATION OF ISOPRENE IN THE PRESENCE OF TITANIUM TETRACHLORIDE. Akio Mitsutani (Kurashiki Rayon Co., Ltd., Japan) and Yoshito Hamamoto. Kogyo Kagaku Zasshi, 67: 1458-60 (Sept. 1964). (In Japanese)

Isoprene solution in hexane including a small quantity of $TiCl_4$ was irradiated with γ rays from ^{60}Co at −196, −78, and 30°C. The rate of irradiation polymerization increased markedly in the presence of $TiCl_4$. The products were resinous and contained 70 to 98% trans-1,4-structure. From the microstructure of the polymer, the mechanism of this radiation polymerization may be cationic. A linear relationship between the rate of polymerization and the dose rate also supported the cationic mechanism. In radioinduced polymerization of isoprene without $TiCl_4$, ionic polymerization occurs at −78°C and radical polymerization at 30°C. Wtihout radiation, isoprene polymerizes only slightly with $TiCl_4$. Therefore the mechanism of the radioinduced polymerization of isoprene with $TiCl_4$ is explained as a cocatalytic action of radiation and $TiCl_4$. In the polymer thus obtained, 10 to 20% was chlorine atoms from $TiCl_4$. It was concluded that isoprene is chlorinated by $TiCl_4$ under radiation and catalyst species are formed during the radioinduced decomposition of $TiCl_4$. (auth)

9200 RADIATION-INDUCED SOLID-STATE POLYMERIZATION OF ACRYLAMIDE AT HIGH PRESSURE. Yoneho Tabata and Toshihiko Suzuki (Tokyo Univ.). Kogyo Kagaku Zasshi, 67: 1460-4(Sept. 1964). (In Japanese)

The polymerization of acrylamide initiated by high-energy radiation was studied in the solid state of the monomer at pressures from 1 to 5000 kg/cm^2 at temperatures from 28 to 70°C. Rates of polymerization and molecular weights were measured. It was found that the rate of polymerization, although suppressed by pressure at the lower temperatures, is accelerated near the melting point. On the other hand, it was also found that the rate of polymerization is suppressed by pressure in the initial stage of polymerization, while it is accelerated in the later stages at the same temperature. The number of polymers obtained was not affected by pressure, but depended only on the radiation dose. These results indicated that pressure has very little effect on the rate of initiation but that the propagation rate constant is profoundly affected by pressure. The effects of the pressure the solid-state polymerization of acrylamide was attributed to the pressure dependence of the activation enthalpy (ΔH) and the activation entropy (ΔS) of the propagation step. (auth)

9201 THE EFFECT OF GAMMA-IRRADIATION ON AQUEOUS SOLUTIONS OF TRIGLYCINE. 2. ELECTROPHORETIC AND PAPER CHROMATOGRAPHIC STUDY OF IRRADIATED TRIGLYCINE. Charles A. Leone (Univ. of Kansas, [Lawrence] and Man Sik Kang. Korean J. Zool., 7: 1-5(Apr. 1964). (COO-1073-10)

Results of experiments to determine whether triglycine contributes to the production of compounds which can compete with it in reactions with free radicals are presented. The approach used was examination of gamma-irradiated aqueous solutions of triglycine. One produce formed a complex with Cu with higher electronegativity than triglycine. Carbonyl compound formation increased under low radiation dosage and decreased under high dosage. Breakage of the peptide bond was indicated. (J.R.D.)

9202 RADIATION-INDUCED POLYMERIZATION OF STYRENE IN THE PRESENCE OF POLYSTYRENE. Hirokazu Tsukahara (Kitsubishi Paper Mills Co. Ltd., Japan) and Koichiro Hayashi. Kubunshi Kagaku, 21: 632-6(Oct. 1964). (In Japanese)

The gel-effect of radioinduced polymerization of styrene in viscous systems was investigated kinetically in the presence of radiation cross-linked polystyrenes of different degree of swelling, linear polystyrenes of different degree of polymerization, and ethylbenzene. Air-free samples were irradiated by gamma rays at a dose rate of 7.0×10^3 r/hr, at 30°C. Observed acceleration of the rate of polymerization of polystyrene, but depended on the concentration of polystyrene. Ethylbenzene, however, caused no acceleration in the rate. Consequently, the kinetics of gamma-induced polymerization of styrene at higher conversions could be investigated by adding cross-linked polystyrene to styrene monomer. When styrene was polymerized in the presence of cross-linked polystyrene, the rate of polymerization, the degree of polymerization, the grafting ratio, and the grafting efficiency increased simultaneously beyond the conversion value of 35%. It was assumed that the concentration of polymer radicals is led to non-steady state in the presence of polystyrene. This assumption was showed reasonable by applying the equation proposed by G. M. Burnett and G. L. Duncan. (auth)

9203 NEUTRON IRRADIATION EFFECT ON CELLULOSE. Tsutomu Sasaki (Mitsubishi Paper Mills Co. Ltd., Japan) and Koichiro Hayashi. Kubunshi Kagaku, 21: 637-41 (Oct. 1964). (In Japanese)

Wood cellulose was irradiated by γ rays from ^{60}Co and neutrons from an atomic pile. The degree of polymerization, copper number, and residual amount of acid hydrolysis of irradiated cellulose were measured. Using corresponding dose basing on the decomposition of polymethylmethacrylate, radiation effects by γ rays and neutron flux were compared. No difference was observed on decreasing of molecular weight. However radiation damage to cellulose crystals was found to be greater in atomic pile and this result was explained as the effect of fast neutrons. (auth)

9204 ELECTRICAL CONDUCTIVITY OF GRAFTED CO-POLYMER INSULATOR UNDER GAMMA-RAY IRRADIATION. Kichinosuke Yahagi (Waseda Univ., Japan). Mem. School Sci. Eng., Waseda Univ., No. 27, 17-22(Dec. 1963).

In the attempt to use a polymer as an electric insulating material, a grafted polyethylene was investigated for the electric conductivity under gamma irradiation. The sample material tested was polyethylene film, about 52 μ thick, onto which methyl methacrylate was grafted with gamma rays. The non-grafted and grafted polyethylene films, which were placed separately in vacuum vessels, were irradiated with gamma rays, with a direct current of 90 v applied to the vessel. The conductivities were measured by a vibrating reed micro-microammeter. As the degree of the grafting was increased, the conductivity decreased (e.g. from 10^{-17} to 10^{-19} Ω-cm^{-1}), the exponent Δ in the relation (induced conductivity) $\propto$ (dose rate)$^{\Delta}$ increased from 0.5 to 0.9, and the activation energy of the induced current decreased (e.g., almost 0 at 9.10 % grafting). These results indicated restriction of the segmental motion of the main chains in the amorphous region by entanglement due to grafting. Thus, it was concluded that the grafted polyethylene may be useful, as a radiation-resistant insulator. (NSA of Japan)

9205 GRAFT COPOLYMERIZATION OF STYRENE ON AMYLOSE IN DIMETHYLSULFOXIDE SOLUTION INDUCED BY γ-IRRADIATION. Akira Mishina (Otani Women's Junior Coll., Japan) and Ziro Nikuni. Nippon Nogeikagaku Kaishi, 38: 372-5(Sept. 1964). (In Japenese)

Studies were made on graft copolymers of hydrophilic and hydrophobic-polymers in the homogeneous system. Amylose and styrene were selected and their solubilities in various solvents checked. It was determined that dimethyl sulfoxide was the best solvent. The grafting was carried out by irradiating the system amylose-styrene-dimethyl sulfoxide with γ rays from ^{60}Co in air or vacuum. The grafting rate was very high compared with other grafting of styrene. The total amounts of polymer formed were almost the same in air and vacuum, and the grafting yield was somewhat higher in air. The molecular weights of the grafted side chains were nearly the same in all the grafting conditions. The grafted side chains were crosslinked in the large dosages. In order to confirm the high grafting rate in this system, various solvents were compared for the radioinduced polymerization of styrene. The results showed that dimethyl sulfoxide is the most effective solvent and the conversion is higher in air than in vacuum. The addition of water accelerated the grafting at the small quantities, but in the mixed system, it was observed that there is a tendency to retard it when over 1%. The infrared spectra of this graft copolymer showed the absorptions overlapped those of amylose and polystyrene, but near 1700 cm^{-1} the absorption due to carbonyl group formed in amylose by irradiation was observed. (NSA of Japan)

9206 ELECTRON SPIN RESONANCE OF IRRADIATED ACETATES. PART 1. Nozomu Takeuchi, Hiroshi Sasakura, and Toshiaki Mizuno. Osaka Furitsu Kogyo-Shoreikan Hokoku, No. 31, 16-17(Nov. 1963). (In Japanese)

Microwave magnetic resonance was employed to study the effect of ionizing γ irradiation on sodium acetate trihydrate. The ($\dot{C}H_3$), ($-\dot{C}H_2$), ($=\dot{C}H$) and ($-\dot{C}O$) radicals are believed to be produced. (auth)

9207 ELECTRON SPIN RESONANCE OF IRRADIATED ACETATES. PART 2. Nozomu Takeuchi, Hiroshi Sasakura, Toshiaki Mizuno, and Masamichi Kitaoka. Osaka Furitsu Kogyo-Shoreikan Hokoku, No. 32, 1-3(1964). (In Japanese)

Electron spin resonance studies were carried out on zinc acetate and ammonium acetate that were subjected to γ-ray irradiation. Experimental line shapes for both samples are the same and in qualitative agreement with the assumption that the hfs interaction is almost averaged over the various equilibrium orientations of the $-CH_2$ group. The smaller signals remain unanalyzed. (auth)

9208 ELECTRON SPIN RESONANCE OF IRRADIATED OXALIC DIHYDRATE. Nozomu Takeuchi, Hiroshi Sasakura, Hisao Kami, Nobuyuki Furuhashi, and Teiji Uemura. Osaka Furitsu Kogyo-Shoreikan Hokoku, No. 32, 9-11(1964). (In Japanese)

The electron spin resonance of single crystal of irradiated oxalic acid dihydrate was observed at room temperature. The stable free radicals produced by irradiation are proposed to be of the forms either ($\cdot$COOH) or ($\mathrm{OC\dot{C}OOH}$) for the singlet, ($\cdot$OH) for the doublet and ($\cdot OH_3$) for the quartet spectra. (auth)

9209 TEMPERATURE DEPENDENCE OF SCINTILLATION RESPONSE IN NaI(Tl), KI(Tl), AND CsI(Tl). E. D. Aluker (Inst. of Physics, Academy of Sciences, Latvian SSR). Phys. Letters, 14: 17-18(Jan. 1, 1965).

The temperature dependence of stationary luminescence on α and x excitation and α-scintillation pulse height was investigated for single crystals of NaI(Tl) and KI(Tl). The α-scintillation pulse height was measured by shifting the maximum of the pulse-height spectrum according to the change in temperature. The results were compared with previous results on CsI(Tl) single crystals. (C.E.S.)

9210 RECOMBINATION LUMINESCENCE FROM V_K CENTERS IN POTASSIUM IODIDE. R. B. Murray and F. J. Keller (Oak Ridge National Lab., Tenn.). Phys. Rev., 137: A942-8(Feb. 1, 1965). (ORNL-P-457)

Experiments with KI to determine whether the near-uv emission characteristic of the pure crystal arises from the recombination of an electron with a V_K center are reported. KI crystals containing Tl or Eu, when irradiated at 77°K with 1.7-Mev electrons, exhibit absorption bands due to V_K and F centers. Illumination of an irradiated crystal in the F band or near infrared results in attenuation of V_K absorption bands and in emission of the 302- and 371-mμ bands characteristic of the pure crystal, as well as in Tl^+ emission. Thermal or optical destruction of V_K centers results in attenuation of the 302- and 371-mμ bands, while the Tl^+ emission remains. Preferential orientation of V_K centers by bleaching with polarized light at liquid-helium temperature or at 77°K results in a polarization of both these emission bands. Assuming that the orienting transition is σ polarized, the 302-mμ band is polarized parallel to the V_K axis, and the 371-mμ band perpendicular. It is concluded that these bands do arise from the radiative decay of a V_K-plus-electron center. (auth)

9211 ON THE ABSORPTION OF SILVER BROMIDE WITH DIVALENT FOREIGN ION ADDITIONS AFTER IRRADIATION. PART II. APPROXIMATION CALCULATIONS OF THE ABSORPTION OF UNIVALENT CHALCOGEN IONS. M. Stasiw (Institut für Kristallphysik, Deutsche Akademie der Wissenschaften, Berlin). Phys. Status Solidi, 8: 139-48(1965). (In German)

The principal photochemical band in irradiated doped AgBr crystals was studied. It was assumed to result from absorption of light by univalent ions. The absorption energy of an O^- ion was calculated using a highly simplified model. The O^- ions, and its environment, are considered as an F-center whose gap is occupied by a chalcogen atom. This calculation uses the method of Gourary and Adrian. (auth)

9212 MEASUREMENT OF RADIATION DOSE DISTRIBUTIONS WITH PHOTOCHROMIC MATERIALS. William L. McLaughlin, and Lyman Chalkley (National Bureau of Standards, Washington, D. C.). Radiology, 84: 124-5 (Jan. 1965).

The use of dyestuff radiosynthesis in colorless solid solutions of certain dye progenitors, in particular derivatives of the triphenyl methane molecule, for dosimetry is reported. Stabilized forms of pararosaniline nitriles, for example, become deeply colored by intense uv irradiation of wave lengths below about 0.32 μ or with large exposures of ionizing radiations. The response range of about one-mil sections of typical sensitizer solutions in plastic is about 0.1 to 100 MR for ^{60}Co gamma rays. This limited range is also a main disadvantage of the system. Some of the advantages are stability, quality and rate independence of response, high spatial resolution, and ease of handling in various media. (P.C.H.)

9213 ELECTRON SPECTRA IN A WATER MEDIUM IRRADIATED BY COBALT-60 GAMMA RAYS. B. Blackburn, D. Jones, G. Bahr, and J. Kereiakes (Univ. of Cincinnati). Radiology, 84: 127-8(Jan. 1964).

An electron scintillation spectrometer using anthracene as the phosphor was used to measure the spectra of electrons scattered by ^{60}Co gamma rays in a simulated tissue medium (water). Measurements were made with circular fields having radii of 10 and 2.5 cm at an SSD of 80 cm and with an open field (without collimation). The spectra were measured at depths of 0.5, 2, 5, 10, and 20 cm along the central axis of the fields; also at lateral distances of 2, 5, and 8 cm with the 10 cm field. For all fields the high-energy spectrum was reduced with increasing depth; but for that portion of the spectrum below 0.3 Mev the greatest dose was delivered at a depth of 2 cm. At depths of 10 and 20 cm attenuation continued to reduce the low-energy dose for finite field size. With open field, though, this portion of the energy spectrum appeared unaffected as the depth increased from 10 to 20 cm. (P.C.H.)

9214 EFFECTS OF X-IRRADIATION ON I^{131}-LABELED HUMAN SERUM ALBUMIN. Titus C. Evans (State Univ. of Iowa, Iowa City). Radiology, 84: 128 (Jan. 1965).

In a search for a chemical dosimeter it was found that ^{131}I-labeled human serum albumin (RISA, Abbott) was affected by moderate doses of x rays. Only 5 to 6% of the ^{131}I of unirradiated RISA adhered to the TRISORB resin sponge (Abbott) after five washes. After irradiation the resin uptake value increased. After investigating the effects of several variables, such as irradiated solution volume, number of sponges, etc., it appeared that under usual conditions there is a direct proportionality between radiation dose and effect with a twofold increased uptake in the sponge following exposures above 10,000 R. The results show the possibility of developing a liquid dosimeter with great versality and also of developing a method of analyzing large molecular aggregates. (P.C.H.)

9215 PHYSICAL AND CLINICAL INVESTIGATIONS UTILIZING A COMMERCIAL LiF DOSIMETER. Waldo D. DeVore and Ernesto A. Fonts (Univ. of Kentucky, Lexington). Radiology, 84: 128-9(Jan. 1965).

Physical characteristics of a LiF dosimeter investigated included: energy dependence; retention of excitation; effects of heat, moisture and other variables; and reliability for calibration of radiotherapy equipment. Many sources of error were found. Reasons for the errors are discussed. A method was developed for preheating the instrument to a constant temperature to avoid changes in sensitivity. It is proposed that after elimination of the sources of error the dosimeter will offer an excellent system for routine clinical dosimetry. (P.C.H.)

9216 THE INTERACTION OF TRANSITION METAL IONS AND HYDROXYMETHYL RADICALS DURING THE RADIOLYSIS OF METHANOL. W. Brackman, F. Van de Craats, and P. J. Smit (Shell Research, Amsterdam). Rec. Trav. Chim., 83: (1253-64(Nov. 1964).

Certain metal ions, in particular Co^{2+}, Ni^{2+} and Cu^{2+} were found to increase the yield of formaldehyde at the expense of glycol during the radiolysis of methanol. The activities of the divalent transition metal ions correlated with the effect of these metal ions upon the quenching of triplet anthracene as measured by Linschitz and Pekkarinen. Both effects are ascribed to rapid complex formation between the metal ions and the $\cdot CH_2OH$ radicals or triplet anthracene. (auth)

9217 CYANAMIDE FORMATION UNDER PRIMITIVE EARTH CONDITIONS. Anneliese Schimpl, Richard M. Lemmon, and Melvin Calvin (Univ. of California, Berkeley). Science, 147: 149-50(Jan. 8, 1965). (UCRL-11771)

Since the dimer of cyanamide, dicyandiamide, is formed upon ultraviolet irradiation of dilute cyanide solutions, and by the electron irradiation of a mixture of methane, ammonia, and water, it is suggested that cyanamide may have had an important role in chemical evolution. (auth)

9218 GAMMA-RAY IRRADIATION OF CINNAMIC ACID AND OTHER COMPOUNDS IN VACUUM OR IN NITROGEN, ETC. S. Ishikawa, K. Kawada, and Y. Soma. Shinku Kagaku, 12: 53-6(Apr. 1964). (In Japanese)

It is well-known that cinnamic acid is changed to various isomers of cyclobutane by UV irradiation or visible rays; and that kitol becomes a dimer of vitamin A by exposing it to sunshine. However, test results showed that γ-irradiation in vacuum or N_2 did not induce polymerization or decomposition in cinnamic and β-phenylethyl acetate. The 1300-c ^{60}Co source of the Toshiba reactor was used at a dosage rate of 3×10^5 r/hr on samples sealed in a colorless test tube in vacuum, or in air, or in N_2. Data from cinnamic acid, its n-hexane solution, n-hexane, cinnamic ethyl, and β-phenylethyl acetate up to dosages of 3.416×10^8 r are given with respect to gas generation, odor, iodine value, acid value, melting point, and reflection index. Their ultraviolet spectra are also discussed. (auth)

9219 KINETICS OF ORIENTED DISLOCATIONS IN IRRADIATED LiF CRYSTALS. I. V. Telegina and E. V. Kolontsova (Moscow State Univ.). Soviet Phys.-Cryst. (English Transl.), 9: 272-6(Nov.-Dec. 1964). Translated from Kristallografiya, 9: 342-6(May-June 1964).

The anomalous scattering method was used to study the defect structure of LiF single crystals after irradiation by neutrons with integral flux values from 5×10^{16} to 10^{19} neutrons/cm² (fast neutrons). The stage of irradiation corresponding to the appearance of two-dimensional dislocations, strictly oriented with respect to the original crystal, was determined. The way in which the size of the dislocations changed during irradiation was established. A possible explanation for the development of the dislocations is proposed. (auth)

9220 ON NUCLEIC ACIDS. H. Leubner (Medizinsche Universitätsklinik, Innsbruck, Austria). Wien Z. Inn. Med. Grenzg., 44: 149-60(Mar. 1963). (In German)

Among other aspects of nucleic acid biochemistry, radiation effects are discussed. (BBB)

9221 RADICALS FORMED IN THE γ IRRADIATION OF TRIOXANE. V. I. Tupikov, S. Ya. Pshezhetskii (Karpov Inst. of Physics and Chemistry, Moscow). Zh. Fiz. Khim., 38: 2430-6(Oct. 1964). (In Russian)

An EPR (electron paramagnetic resonance) study was made of the radicals formed in the γ-irradiation of a trioxane monocrystal at −196°C. The biradicals $\dot{O}-CH_2-O-CH_2-O-\dot{C}H_2$, molecular ion radicals, and paramagnetic structures giving a weakly split singlet are formed. Moreover, decomposition of the ring with formation of formyl radicals occurs. The radical concentration increased on heating the γ-irradiated trioxane crystals, which may be due to recombination of the ions with the electrons freed from the traps. The molecular ion radicals and the radicals characterized by weak splitting of the singlet are retained on heating up to +50°C. They may therefore be initiators of the chain postpolymerization of trioxane. (auth)

9222 DETERMINATION OF THE OPTIMAL CONDITIONS FOR THE RADIATION CHEMICAL SYNTHESIS OF DIBUTYLTIN DIBROMIDE. B. S. Averbukh, L. V. Abramova, A. Kh. Breger, B. I. Vainshtein, V. A. Gol'din, K. A. Kocheshkov, N. P. Syrkus, N. K. Shalyapin, and N. I. Sheverdina (Karpov Inst. of Physics and Chemistry, Moscow). Zh. Fiz. Khim., 38: 2445-8(Oct. 1964). (In Russian)

Descriptions are given of a radiochemical synthesis of dibutyltin dibromide using crude industrial tin. Intense mixing and an optimum ratio of $q_{Sn} : q_{C_4H_9Br} = 1:2$ achieved ~85% transformation, with a radiochemical yield (at 40°C) of 60 molecules/100 ev. An increase of the temperature to 85°C increased the yield to 180 molecules/100 ev. (R.V.J.)

9223 FORMATION OF FREE RADICALS IN THE γ-RADIOLYSIS OF AQUEOUS SOLUTIONS OF AMMONIA AND HYDRAZINE. V. I. Tupikov and S. Ya. Pshezhetskii (Karpov Inst. of Physics and Chemistry, Moscow). Zh. Fiz. Khim., 38: 2511-13(Oct. 1964). (In Russian)

Experimental studies of the radiolysis of frozen aqueous solutions of ammonia and hydrazine revealed electron paramagnetic spectra of a free radical which appeared in the ammonia solution as NH_2 and in the hydrazine as N_2H_3. The yield of radicals was a function of the composition of the solutions and depended on the energy transition from the water molecule to ammonia and hydrazine molecule and the low temperature reaction of OH radicals with ammonia and hydrazine molecules. (R.V.J.)

9224 FREE RADICAL FORMATION INDUCED BY β RAYS FROM TRITIUM RADIOLYSIS OF CYCLOHEXANE AND n-HEPTANE. I. V. Berezin and K. Martinek. (Moscow State Univ.). Zh. Fiz. Khim., 38: 2702-3(Nov. 1964). (In Russian)

Radiolysis of cyclohexane and n-heptane using tritium labeling ($C_{24}H_{45}T/C_{24}H_{46} \sim 0.01\%$) produced 1600 ± 200 cyclohexyl or heptyl free radicals. The reaction was not affected by temperature. Additions of p-benzoquinone or iodine (10^{-3}M) inhibited the free radical exchange: $R^0 + R_1H(R_1T) \rightarrow \overline{R}_1 + RH(RT)$ (where R_1H is $C_{24}H_{45}T$ and RH is C_6H_{12}). (R.V.J.)

9225 THE PART PLAYED BY EXCITED ETHYL RADICALS AND HOT HYDROGEN ATOMS IN THE RADIOLYSIS OF ETHYLENE. B. G. Dzantiev and A. P. Shvedchikov. Zh. Fiz. Khim., 38: 2739-42(Nov. 1964). (In Russian)

High-pressure ethylene radiolysis using n,γ reactor radiation and heavy particles produced in nuclear reactions $^6Li(n,\alpha)T$ and $^{10}B(n,\alpha)^7Li$ was studied. The C_2H_6/C_4H_{10} ratio in pure ethylene and ammonia-ethylene mixtures was higher than 0.2 ± 0.1 for the ethyl radical disproportionation and recombination reactions. The mechanism of ethylene radiolysis excitation reaction of ethyl radicals $C_2H_5^{\ddagger}$ produced by ethylene combination with hot radiolytic hydrogen was analyzed. According to the mechanism, ethylene is formed by the active radical C_2H_5 stripping hydrogen from RH molecules. (R.V.J.)

9226 RADIOLYSIS OF SOME CONJUGATED DIENES. V. S. Ivanov, Yu. V. Medvedev, Hou Kuei, and A. A. Taran. Zh. Obshch. Khim., 34: 3853(Nov. 1964). (In Russian)

Radiolysis and polymerization induced by γ radiation in conjugated dienes (divinyl, isoprene, piperylene, diisopropenyl, and chloroprene) were investigated. The data obtained indicated a prevailing rupture of the C-H bond in comparison to the C-C bond. Radiolysis accompanied by destruction of the carbon skeleton stripped the methyl groups and the 2−3 bonds. Radiostability of conjugated methyl group was a function of displacement position, and increased according to the series: piperylene − diisopropenyl − isoprene. It was postulated that some radiolytic products inhibit polymerization. (R.V.J.)

9227 ACTIONS CHIMIQUES ET BIOLOGIQUES DES RADIATIONS. HUITIEME SERIE. (Chemical and Biological Actions of Radiations. Eighth Series). M. Haissinsky. Paris, Masson et Cie, 1965. 252p. 86 F.

Three sections are included; separate abstracts were prepared for each. (P.C.H.)

For abstracts of individual sections see: 9228, 9229, and 9230.

9228 DISSOCIATION PROCESSES IN ELECTRONICALLY EXCITED MOLECULES. Koichi Funabashi and John L. Magee (Univ. of Notre Dame, Ind.). p.1-26 of "Actions Chimiques et Biologiques des Radiations. Huitieme Serie." Paris, Masson et Cie, 1965.

A theoretical consideration of dissociation processes in electronically excited molecules is presented. It is a part of continuing efforts to develop a theory of the action of high energy radiation on matter. An attempt is made to make clear how this work relates to the theory of the chemical action of high energy radiation. Discussion is presented on formulation, classification of electronic interaction, electron migration, and dissociation processes. The model presented allows a complete investigation of the excitations of vibrations and dissociations by transient electronic states. It is shown that a reasonable classification is made on the basis of the time dependence of the system of equations rather than on the basis of the magnitudes of the various significant interaction energies. (P.C.H.)

9229 ELECTRONIC ATTACHMENT IN THE GASEOUS PHASE. Florence Fiquet-Fayard (Universite de Paris, Orsay, France). p.29-104 of "Actions Chimiques et Biologiques des Radiations. Huitieme Serie." Paris, Masson et Cie, 1965. (In French)

Information is included on electronic attachment (capture) on isolated molecules, measurement of total ionization, and electronic attachment in the gas. Results of specific experiments on hydrogen, iodine, water, and oxygen are discussed. (P.C.H.)

9230 PRIMARY PHYSICAL AND CHEMICAL EFFECTS ASSOCIATED WITH EMISSION OF RADIATION IN NUCLEAR PROCESSES. S. Wexler (Argonne National Lab., Ill.). p.105-241 of "Actions Chimiques et Biologiques des Radiations. Huitieme Serie." Paris, Masson et Cie, 1965.

A review is presented on the salient phenomena encountered in atoms and molecules after a nuclear transformation. Information is included on beta decay (both electron and positron emission), alpha emission, isomeric transition, orbital electron capture, radiative neutron capture, and nuclear fission. (P.C.H.)

9231 RADIATION STABILITY OF ANIONITES. E. D. Kiseleva, K. V. Chmutov, and A. B. Pashkov. p.163-72 of "Issledovanie Svoistv Ionoobmennykh Materialov." Moscow, Izdatel'stvo "Nauka," 1964. (In Russian)

Data are presented on the effects of ionizing radiation on styrene copolymers with divinylbenzene with various exchange groups (AV-17, AV-27, AN-24, and AV-18). Irradiation of anionites in the OH-form was carried out using a flux of electrons from an accelerator in distilled water or in $7\underline{N}$ HNO_3 solutions. The radiation doses varied from 0.05×10^{22} to 2.0×10^{23} ev/g. Curves of anionite volume and swelling as functions of radiation doses were analyzed and physicochemical properties of various irradiated anionites are tabulated. (R.V.J.)

9232 CONTRIBUTION TO THE MAGNETIC RESONANCE HYPERFINE SPECTRA OF dlα-ALANINE IRRADIATED BY X-RAYS AS A FUNCTION OF TEMPERATURE. STERIC EFFECTS AND DEFORMATION OF CH_3 GROUP. M. X. Delbousquet (Université, Bordeaux). p.176-81 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964. (In French)

The variation of electron paramagnetic resonance spectra for the irradiated dlα alanine, observed by Horsfield, Morton, and Whiffen on cooling to 77°K, was studied from 300 to 77°K. The curves of the change of the hyperfine couplings of the methyl protons were drawn. Cessation of rotation of CH_3 was interpreted by an important steric effect. The deformation of CH_3 is explained by a function φ. (auth)

9233 EPR SIGNAL OF IRRADIATED THIOSULFATE. R. Servant (Université, Bordeaux). p.182-4 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964. (In French)

Sodium thiosulfate was irradiated with gamma or x rays because of the presence of fragile semi-polar bonds. The electron paramagnetic resonance signals are described for hydrated monocrystals. A comparison was made between these signals and those obtained with a previously dehydrated crystal. (auth)

9234 ELECTRON SPIN RESONANCE OF 1-Mev ELECTRON IRRADIATED SINGLE CRYSTALS OF BETAINE. G. Schoffa (Technische Hochschule, Karlsruhe, Ger.). p.185-7 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964.

Betaine, irradiated with 1-Mev electrons, was examined by electron spin resonance at 9.4 kMc/sec for various orientations of the crystals in the static magnetic field. The resonance pattern of the stable free radical produced by the irradiation was found to have lines separated by 28 gauss arising from nine equivalent methyl protons. Each of these lines was split in a triplet caused by coupling to a ^{14}N nucleus. All methyl protons coupled equally, due to the rotation of the methyl groups about the $N-(CH_3)_3$ bond. This coupling was interpreted as arising from s orbital spin density of the hydrogens, via hyperconjugation. Two nonequivalent radical sites were detected. Completed coupling tensors, and the g factor tensor, are given. (auth)

9235 ELECTRONIC RESONANCE OF IRRADIATED GLYCINE SINGLE CRYSTALS. EFFECT OF TEMPERATURE AT 9000 MHz. A. Bottreau (Université, Bordeaux). p.188-90 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964.

Experimental results obtained by irradiating single crystals of glycine with γ rays or x rays are presented. The evolution of irradiated single crystals, the static resonance H_0, and spectral variation for some orientation of single crystals, when the temperature of the samples is lowered, are discussed. (auth)

9236 ELECTRONIC SPIN RESONANCE STUDY OF THE RADIORESISTANCE OF AMINO ACIDS AND POLYPEPTIDES. J. Depireux (Université, Liege) and A. Mueller. p.262-8 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964. (In French)

Electron spin resonance was used to determine the free radical yield in x-irradiated amino acids, namely aliphatic glycylglycine and aromatic L-tyrosine and L-tryptophan. Molecular mixtures of these compounds prepared by freeze-drying were also studied. The quantitative results did not support the idea of the occurrence of molecular interactions between constituents of the mixture. On the contrary, when both components were bound together by a peptide bond to form simple peptides, glycyl-L-tyrosine and glycyl-L-tryptophan, a marked protection of the aliphatic chain by the aromatic ring system was observed. (auth)

9237 CONTRIBUTION TO THE STUDY OF IRRADIATION EFFECTS ON CELLULOSE BY E.P.R. O. Bernard and D. Gagnaire (Centre d'Etudes Nucleaires, Grenoble, France). p.269-75 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964. (In French)

Two classes of radicals were observed by electronic paramagnetic resonance on irradiated cellulose. The action of water permitted separation of these two classes. Though it was difficult to evaluate their true nature, it seemed possible to develop a hypothesis on the formation of one type of radical on carbon 6 and another type on carbons 2 and 3. These radicals were used to initiate copolymerization reactions to obtain grafted compounds of cellulose. (auth)

9238 E.S.R. OF A NEW FREE RADICAL IN SODIUM FORMATE. R. E. Bellis and S. Clough (University Coll. of North Wales, Bangor, Wales). p.291-3 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964.

After heating to 185°C, irradiated crystals of sodium formate contained a free radical exhibiting an interaction with a single proton. The interaction tensor and the g tensor were determined. The structure of the radical is discussed. (auth)

9239 ELECTRON PARAMAGNETIC RESONANCE IN IRRADIATED SODIUM NITRATE. R. Adde, L. Guibe, and P. Petit (Universite de Paris, Orsay, France). p.559-61 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964. (In French)

Single crystals of sodium nitrate irradiated with 1.5-Mev electrons at room temperature were studied by electron spin resonance. The spectra of a paramagnetic species showing hyperfine structure due to a single nitrogen nucleus was analyzed. (auth)

9240 ELECTRON PARAMAGNETIC RESONANCE SPECTRA OF SOME ALCOHOLS IRRADIATED AT 77°K BY γ RAYS. C. Chachaty and E. Hayon (CEN, Saclay, France). p.570-5 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964. (In French)

Gamma irradiation of alcohol glasses at 77°K gave rise to two electron spin resonance spectra, which were superimposed: a multiplet due to the radical R−CHOH, and a single line, which attempts were made to identify. From the disappearance of this single line on irradiation in the presence of compounds having a high electron affinity, it was concluded that it corresponds to electrons trapped in the glass. The action of visible and uv light on gamma-induced paramagnetic centers was also studied. In the course of this work the formation of other radicals such as R−CH_2O, was demonstrated. (auth)

9241 ON THE IRRADIATION OF ANNEALED POLYETHYLENE CRYSTALS. R. Salovey and D. C. Bassett (Bell Telephone Labs., Inc., Murray Hill, N. J.). 34p. (CONF-543-9).

From American Physical Society 1964 Meeting, Philadelphia, Mar. 1964.

The amount of gel formed on irradiation of polyethylene crystals was studied. For all specimens the efficiency of gelation lies between two extremes. Films prepared by filtering crystals from suspension with a constant pressure difference, decreased in gel for increasing film thickness. At constant film thickness gel increased with increasing pressure difference. Low-angle x-ray diffraction showed that lamellae are more tightly packed in films giving higher gel. When films were heated above the temperature at which their crystals were grown, characteristic changes in gel occurred. The principal one is a rapid increase once crystals start to thicken. It is suggested that two other changes in gel, an initial decrease on annealing and an increase on storing at room temperature, arise from a smoothing of fold surfaces. The results are consistent with and support the hypothesis that radioinduced cross-linking occurs preferentially between chain-folds of adjacent lamellae, reduced gelation being due primarily to imperfect lamellar contact. Alternative explanations in terms of solvent retained in aggregates are excluded. (auth)

Radiochemistry

9242 (ORNL-P-784) PREPARATION OF ULTRA PURE CALCIUM CARBONATE FROM ELECTROMAGNETICALLY PRODUCED ^{48}Ca FOR CALCIUM FLUORIDE OPTICAL CRYSTAL GROWTH. J. O. Younghanse, R. L. Bailey, H. R. Gwinn (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 6p. (CONF-641110-1) Dep.(mn); $1.00(cy), 1(mn) OTS.

From Tennessee Academy of Science Meeting, Memphis.

A single crystal of ^{48}Ca fluoride was found to be contaminated with U in an estimated amount of ~ 1 ppm. The crystal was repurified by carbonate precipitation, and another fluoride crystal was grown. The alpha activity was found to be reduced by a factor of 5 over that in the original crystal. (D.L.C.)

9243 HYDROGEN EXCHANGE AT CARBON−HYDROGEN SITES DURING ACID OR ALKALINE TREATMENT OF PROTEINS. Julie Hill and S. J. Leach (C.S.I.R.O., Melbourne). Biochemistry, 3: 1814-18(Dec. 1964).

When proteins were treated with alkali or hot acid, exchange was promoted between hydrogen atoms at CH sites and hydrogen atoms in the aqueous medium. The extent of such exchange was estimated by incorporating tritiated water in the solutions during treatment, removing the labile tritium atoms bound at NH and OH sites, and estimating the residual tritium in the protein by liquid-scintillation counting. Under the conditions normally used for the acid hydrolysis of proteins prior to amono acid analysis, 30−42 g-atoms of hydrogen were exchanged at CH sites per 10,000 g of insulin, lysozyme, ribonuclease, and wool keratin. Examination of the individual amino acids separated by chromatography showed that their susceptibilities to such exchange were closely similar among different proteins. Aspartyl and glutamyl residues were the most readily labeled (1-2 g-atoms of hydrogen/residue), followed by tyrosyl (approximately 1 g-atom of hydrogen/residue). These three acids were also the most readily labeled when a synthetic mixture of amino acids was treated with acid under the same conditions. Optical-rotation measurements showed that the exchange produced very little racemization and probably occurred at CH sites in the β or γ position relative to the peptide bond. Hydrogen exchange at CH sites in proteins occurred also at pH 12.5 at room temperature, but the residues affected in this case were glycyl, seryl, threonyl, aspartyl, and cystyl. The extent of exchange in alkaline solution varied much more between proteins than in acid solution. Like racemization, it did not occur readily with free amino acids and probably involved exchange at CH sites in the α position. (auth)

9244 STUDY OF ADDITION COMPOUNDS OF LEWIS ACIDS. XXII[1]. EXCHANGE OF RADIOACTIVE CHLORINE BETWEEN $AlCl_3$ AND C_6H_5COCl. G. Oulevey and B. P. Susz (Université, Geneva). Helv. Chim. Acta, 47: 1828-32(1964). (In French)

A method for studying the exchange of chlorine between C_6H_5COCl and $AlCl_3$ labeled with ^{36}Cl was worked out. It consists of removing rapidly C_6H_5COCl from the addition compound $C_6H_5COCl,A[^{36}Cl]_3$, formed in CS_2 with p-dioxane, which in turn gives an addition compound p-dioxane, $AlCl_3$. The latter compound is stable enough to be easily isolated and lends itself well for the measure of the radioactivity of ^{36}Cl. Even after only 2 minutes of contact, and at variable stoichiometric ratios between C_6H_5COCl and $Al[^{36}Cl]_3$, the exchange of chlorine is complete. This result is consistent with the presence of $[AlCl_4]^-$in the addition compound. (auth)

9245 MICROCALORIMETRIC ACTIVITY MEASUREMENTS OF RADIONUCLIDES. H. Ramthun. Acta IMEKO (Intern. Messtech. Konf.), 1964, 439-52. (CONF-640902-1). (In German)

In measuring the absolute and relative activity of radioactive isotopes, the difficulties generally arising in the course of such measurements can be eliminated to a great extent by the application of a microcalorimeter. The elimination of the absorption correction is described. In the case of total radiation absorption and of satisfactorily strong sources heat power can be measured with an accuracy of $\pm 1.10^{-4}$. Identical preparations can be compared with similar accuracy, or the decrease of the activity of a preparation can be followed. This possibility has significance for measuring half lives of an order of magnitude of 10 years. For determining absolute activity a knowledge of the average energy emitted in one decay is necessary. Extension of the calorimetric determination of activity was hampered by the necessary minimum source intensity. In the case of a limit sensitivity of 10^{-6} watts heat power the measurable minimum activity for the isotope is about 10^{-2} curie. One mC ^{32}P, for example, supplies 4.15×10^{-6} watts. A high-sensitivity double calorimeter was developed which compares the heat power of the source with the Joule heat of an electric current. This apparatus was designed especially for measuring corpuscular radiation and its sensitivity is 10^{-8} watts. A measuring accuracy of 10^{-7} watts was obtained. For measuring thermovoltage a photoelectric amplifier with sensitivity of 5×10^{-10} v was employed. The temperature of the mantle of the calorimeter was kept constant by a thermostat at the value 25 ± 0.001°C. For the thermostat control a bridge circuit with two platinum and manganin resistances, a resonance amplifier, and a phase dependent rectifier were used. (auth)

9246 MEASUREMENTS OF RADIOACTIVE AEROSOLS AND LOW LEVEL BETA ACTIVITIES USING SIMPLIFIED AND RELIABLE CIRCUITS. B. J. Kovač, S. D. Muždeka, P. B. Frantlović, D. M. Spasojevič, and M. M. Božovič. Acta IMEKO (Intern. Messtech. Konf.), 1964, 453-63. (CONF-640902-5)

Studies were made of nuclear radiation detectors as switching elements for simplifying electronic instruments. Such studies resulted in the design of a simple anticoincidence circuit consisting of the parallel connection of two G−M counters. This connection makes possible direct anticoincidence output without use of the standard electronic anticoincidence units, thus increasing the reliability of the system to the highest possible degree. This simplifying of circuitry does not cause any change in the working conditions prescribed for G–M counters, so they retain their usual long life. The results obtained from the measurements were identical with those obtained on standard commercial apparatuses that employ detectors of the same type and an anticoincidence unit. Two instrument units, one for the measurement of the low level beta activities and the other for continuous measurement of radioactive aerosols, were designed using the anticoincidence circuit described. In the first apparatus the cold cathode decade counter tube and the mechanical counter were triggered by cold cathode trigger tubes. The background was less then 1 cpm. In routine measurements samples with 10^{-12}C activity were measured. The same detector system was used for the measurement of filter-paper activities in an apparatus for continuous measurement of radioactive aerosols. The measuring system contained a logarithmic ratemeter (4 decade) with passive elements. The apparatus was able to detect activity concentration of less than 10^{-13}C/m^3. Neither instrument contained thermoionic valves, and for the sake of reliability the components were reduced to the smallest possible number. (auth)

Separation Processes and Procedures

Refer also to abstracts 9362, 9410, 10562, and 10677.

9247 (BM-RI-6577) EXTRACTION AND SEPARATION OF RARE-EARTH ELEMENTS IN IDAHO EUXENITE CONCENTRATE. Van E. Shaw and D. J. Bauer (Bureau of Mines. Reno Metallurgy Research Center, Nev.). May 1964. 15p. Free(Bureau of Mines)

Conversion of euxenite concentrate to sulfates with sulfuric acid and solvent extraction of the yttrium–rare-earth mixture with EHPA were studied to determine extraction and separation characteristics. Digestion with 3.5 pounds of 96 percent sulfuric acid per pound of concentrate at 336°C for 4 hours resulted in an easily handled product with a yield in excess of 98 percent. A thorium-free product was obtained by calcining the sulfated material for 3.5 hours at 650°C prior to leaching with water. Di(2-ethylhexyl)phosphoric acid solvent is an effective extractant with preference for cerium (IV) and heavy-group rare-earth elements including yttrium. Separation of complex rare-earth mixtures into light- and heavy-group fractions is feasible, and these fractions can be further processed to isolate ytterbium, neodymium, and dysprosium by changing processing conditions to obtain separation factors greater than two between these and adjacent elements. (auth)

9248 (BM-RI-6580) RECOVERY OF SCANDIUM FROM URANIUM PLANT IRON SLUDGE AND FROM WOLFRAMITE CONCENTRATES. J. R. Ross and C. H. Schack (Bureau of Mines. Salt Lake City Metallurgy Research Center). May 1964. 25p. Free(Bureau of Mines).

Techniques for recovering scandium from uranium plant iron sludges and from wolframite concentrates are described. The best procedure found comprised (1) dissolution with sulfuric acid, (2) preliminary concentration by solvent extraction with a primary alkyl amine, (3) further enrichment and purification by a combination of ion exchange, solvent extraction, chemical precipitation, and calcination. Recovery of scandium from these raw materials, which contained 0.058 and 0.14 percent scandium, ranged from 83 to 90 percent in products analyzing 99.6 to 99.9 percent scandium oxide. (auth)

9249 (DP-923) GAS FORMATION IN ANION EXCHANGE RESIN BEDS. E. Kenneth Dukes, Glenn A. Burney, and Richard M. Wallace (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1964. Contract AT(07-2)-1. 15p. Dep.; $1.00(OTS).

Gas formed in fixed beds of anion exchange resin is difficult to remove and causes channeling and reduction in flows. The major source of gas in resin beds used to recover actinides from nitrate solutions is the reaction of sulfamate ion with nitrous acid, which produces nitrogen. Two approaches to minimizing gas formation are: completely destroy sulfamate in a feed pretreatment, or replace sulfamate with a non-gas-forming stabilizer. (auth)

9250 (HW-65323) DISSOLUTION OF ZIRCALOY-CLAD ALUMINUM PLUTONIUM FUEL ELEMENTS. R. Sorenson and W. W. Schulz (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 17, 1960. Contract AT(45-1)-1350. 11p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A discussion is given of work in progress toward development of a reprocessing scheme for a proposed PRTR spike fuel element. Emphasis is placed on the kind of problems one may encounter in developing procedures for reprocessing a given nuclear reactor fuel, particularly when the procedure developed must fit into existing processes and facilities. Based on work completed to date, it must be concluded that the inclusion of silicon in plutonium–aluminum alloy fuels results in serious reprocessing problems if the separation and decontamination of plutonium are to be done by Redox-type solvent extraction. The presence of colloidal silica in solvent extraction feed solutions prepared from such alloys gives rise to severe emulsion formation during solvent extraction. The only reliable solution found so far tc the emulsion problem is to dissolve the fuels in nitric acid of relatively high concentration. Feed solutions prepared in this fashion do not show severe emulsion forming characteristics. However, dissolution rate is low in high acid and excessively long dissolution time cycles are required. Also, post-dissolution destruction or neutralization of excess acid is required to attain the low-acid feeds required for Redox solvent extraction. (auth)

9251 (ORNL-3725) DISSOLUTION OF IRRADIATED, STAINLESS-STEEL-CLAD ThO_2-UO_2 IN FLUORIDE-CATALYZED NITRIC ACID SOLUTIONS: HOT-CELL STUDIES ON PELLETIZED, ARC-FUSED, AND SOL-GEL-DERIVED OXIDES. J. H. Goode and J. R. Flanary (Oak Ridge National Lab., Tenn.). Jan. 1965. Contract W-7405-eng-26. 25p. Dep.; $2.00(OTS)

Hot-cell tests on the batch dissolution and leaching of irradiated sol-gel-derived, pelletized, or arc-fused ThO_2-UO_2 in boiling Thorex reagent, 13$\underline{M}$ HNO_3 – 0.04$\underline{M}$ NaF – 0.04$\underline{M}$ $Al(NO_3)_3$, indicated that irradiation increased the dissolution rate over unirradiated oxides, with up to 95% in solution at 8 hr and 99.8% in 24 hr. Greater than 99.8% of the thorium and uranium was recovered in leaching tests with sheared fuel pieces. When stainless steel claddings were dissolved with 6$\underline{M}$ H_2SO_4, uranium and thorium losses were as high as 0.33%, and the decladding solutions contained up to 3.6% of the total cesium. Irradiation levels varied from 3000 to 98,000 Mwd/metric ton (Th + U). The macro amounts of fission products from these highly-irradiated specimens were soluble in the product solutions which contained up to 1$\underline{M}$ thorium and a total of 0.05$\underline{M}$ fission products. Cyclic dissolutions, leaving a 5 to 6% "heel" of undissolved material, produced a 1$\underline{M}$ thorium product solution after a 5-hr dissolution period. The residues consisted of undissolved ThO_2-UO_2, cladding, corrosion products, and contaminants from the fuel rods such as insulation, alumina from ball-milling, etc. The thorium and uranium could be recovered from the "heel" by leaching with fresh Thorex reagent to produce overall recoveries of greater than 99.8%. (auth)

9252 (ORNL-3732) EFFICIENCY AND FLOW CAPACITY OF PULSED COLUMNS USED FOR THE SEPARATION OF URANIUM FROM THORIUM BY SOLVENT EXTRACTION WITH DI-sec-BUTYLPHENYLPHOSPHONATE. A. D. Ryon and R. S. Lowrie (Oak Ridge National Lab., Tenn.). Jan. 1965. Contract W-7405-eng-26. 35p. Dep.; $2.00(OTS)

Engineering studies were made to evaluate flow capacity and efficiency of sieve-plate pulsed columns, using the di-sec-butylphenylphosphonate solvent extraction process for separating uranium from thorium. The process was demonstrated to be capable of providing ^{233}U feed solution for the sol-gel process in the Kilorod program. Process throughput was limited by the stripping column flow capacity. Operating the stripping column at a pulse frequency of 70 cpm gave a flow rate of 380 gal hr^{-1} ft^{-2}, compared with 700 gal hr^{-1} ft^{-2} at the same pulse frequency for the compound extraction scrub column. HETS values at this pulse frequency were 4.2 ft for uranium stripping, 2.1 for uranium extraction and 4.1 for thorium scrubbing. Decontamination factors (uranium from thorium) were consistently better than 10,000, and the nitrate-to-uranium ratio in the stripping-column product was less than 2.3. Procedures for determining column flow capacity and efficiency are also described. (auth)

9253 (UJV-1115/64) SORBTSIYA RADIOAKTIVNYKH IZOTOPOV ^{32}P, ^{35}S, I ^{131}I NA IONNYKH OSADKAKH I GIDRATIROVANNYKH OKISYAKH. (Sorption of Radioactive Isotopes ^{32}P, ^{35}S, and ^{131}I by Ionic Precipitates and Hydrated Oxides). F. Kepak (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). [1964]. 15p. Dep.(mn).

The sorption of the radioactive isotopes ^{32}P, ^{35}S, and ^{131}I (phosphate, sulfate, and iodide anions) on hydrated metal oxides, barium sulfate, natural barite, and hydrated iron, aluminum, and aluminum-zinc alloy was investigated. A high-efficiency sorption of phosphate ion was achieved with barium sulfate. Iodide ion was efficiently sorbed by silver-activated hydrated iron oxides. Sorption properties of the investigated sorbents were analyzed for efficient separation of radioactive isotopes from aqueous solutions (tr-auth)

9254 (ANL-Trans-144) A STUDY OF MASS TRANSFER IN A PULSED EXTRACTION COLUMN WITH ROTATING FLOW. V. I. Doronin and A. M. Nikolaev. Translated by C. E. Stevenson (Argonne National Lab., Ill.), from Izv. Vysshykh Uchebn. Zavedenii, Khim. i Khim. Tekhnol., 7: 665-8(1964). 8p. Dep.(mn); $1.00(cy) 1(mn) OTS; $1.10(fs), $0.80(mf) JCL.

A laboratory study was made on the extraction of uranyl nitrate from HNO_3 solutions by TBP–kerosene in a pulsed column with alternating plates with oppositely directed orifices for inducing rotating flow. The results show that the efficiency does not depend on the feed rates or relative phase volumes, that the efficiency is a simple power function of the pulsing intensity, and that an increase of the pulsation frequency and a decrease of the height of the sections results in increased mass transfer. (D.L.C.)

9255 EXTRACTION OF Tc(VII) BY TRILAURYLAMMONIUM NITRATE IN XYLENE. Anna Beck, David Dyrssen, and Solveig Ekberg (Royal Inst. of Tech., Stockholm). Acta Chem. Scan., 18: 1695-1702(1964).

The distribution of $^{99}TcO_4^-$ between solutions or trilaurylammonium nitrate (R_3NHNO_3) in o-xylene and aqueous solutions of HNO_3 and $LiNO_3$ was measured at 25°C. In 1 $\underline{M}$ $(H,Li)NO_3$ and 0.015 $\underline{M}$ R_3NHNO_3 the overall equilibrium constant for the ionic exchange reaction is represented by $TcO_4^-\ (aq) + (R_3NHNO_3)_n\ (org) \rightleftharpoons NO_3^-\ (aq) + (R_3NH)_n\ (NO_3)_{n-1}\ TcO_4\ (org)$ is $\log K = 2.20$, where K = (total conc. of Tc in org phase) × (total conc. of NO_3^- in aq phase)/(total conc. of Tc in aq phase) × (total conc. of NO_3^- in org phase). Experiments, in which the total nitrate concentration in either phase was varied, support the ion exchange reaction even if K is somewhat dependent on the concentration. The influence on K of the amine nitrate concentration in the organic phase below 1% can be explained by the following reactions: $TcO_4^-\ (aq) + R_3NHNO_3\ (org) \rightleftharpoons NO_3^-\ (aq) + R_3NHTcO_4\ (org)$; $K_1 = 8$ and $TcO_4^-\ (aq) + (R_3NHNO_3)_2\ (org) \rightleftharpoons NO_3^-\ (aq) + (R_3NH)_2NO_3\ TcO_4\ (org)$; $K_2 = 850$. (auth)

9256 INORGANIC ION EXCHANGERS. III. EQUILIBRIUM STUDIES ON ZIRCONIUM PHOSPHATE GELS. Sten Ahrland and Joergen Albertsson (Univ., Lund, Sweden). Acta Chem. Scan., 18: 1861-78(1964).

Sorption on zirconium phosphate gels was investigated for a number of ions, which are of importance for the processing of irradiated nuclear fuels, viz. U(IV), UO_2^{2+}, Ce^{3+}, Y^{3+}, Sr^{2+}, Cs^+, Rb^+, and Na^+. For gels of a high ratio of phosphate to zirconium $\gtrsim 1.5$, the sorption took place as an ideal cation exchange, except in the case of U(IV), which reacted irreversibly with the phosphate groups of the gels. For gels of a low phosphate to zirconium ratio, on the other hand, more metal ions were sorbed than hydrogen ions released. Such gels thus retained part of the amphoteric character of zirconium hydrous oxide. Besides the ordinary monohydrogen phosphate groups, which made up the vast majority of the sorption sites, the gels also contained small amounts of another functional group of high affinity to certain cations, especially Cs^+. This led, among other things, to a very selective sorption of Cs^+ and Rb^+ at low loads. The selectivity of the gels decreased with increasing phosphate content, but was still fairly satisfactory even at a phosphate to zirconium ratio $\simeq 2$, which is the highest value that can be reached. The hydrolysis of the gels (which becomes extensive as pH exceeds a value of $\simeq 8$) depends appreciably upon the cations present in the solution. For a certain value of pH, it decreased along the sequence $Na^+ > Rb^+ > Cs^+$. From neutralization curves obtained in Cs^+ and Rb^+ media, it seemed as if the "ordinary" monohydrogen phosphate groups would exist in two states of different acidity. (auth)

9257 ION EXCHANGE SELECTIVITY SCALES FOR CATIONS IN NITRIC ACID AND SULFURIC ACID MEDIA WITH A SULFONATED POLYSTYRENE RESIN. F. W. E. Strelow, Ruthild Rethemeyer, and C. J. C. Bothma (South African Council for Scientific and Industrial Research, Pretoria). Anal. Chem., 37: 106-11(Jan. 1965).

Cation exchange equilibrium distribution coefficients with BIO-RAD AG 50W-X8, 100- to 200-mesh, a sulfonated polystyrene resin, are presented for 49 cations in nitric acid and 45 cations in sulfuric acid media. The coefficients were determined at a total amount of cation to total resin capacity ratio q = 0.4, to ensure comparability with coefficients in hydrochloric acid determined previously. Acid concentrations from 0.1 to 4.0$\underline{N}$ were used. The coefficients are arbitrarily arranged into selectivity scales according to their values in 1$\underline{N}$ acid. Included are elution curves for the multicomponent systems V(V)–U(VI)–Sc(III)–Y(III); Na(I)–Be(II)–Ba(II)–Y(III)–Zr(IV); and Hg(II)–Cd(II)–Be(II)–Fe(III)–Ba(II)–Zr(IV) to demonstrate some possibilities inherent in cation exchange separation. (auth)

9258 THE SOLVENT EXTRACTION OF RUTHENIUM WITH 8-HYDROXYQUINOLINE. Toyoaki Kato (Tohoku Univ., Sendai). Bull. Chem. Soc. Japan, 37: 1453-60(Oct. 1964).

The solvent extraction behavior of ruthenium(IV) with 8-hydroxyquinoline was investigated using ^{106}Ru as a tracer. Complex formation in the aqueous phase was fairly slow and was the limiting step in the procedure, but could be enhanced by heating. Complete extraction was attainable with $\underline{n}$-butanol, benzene and other organic solvents after 8-hydroxyquinolate was formed by one hour's heating at 60°C with the excess reagent in an aqueous acetate medium of pH 4 to 6. The $\underline{n}$-propanol, especially when combined with $\underline{n}$-butanol was an efficient extraction solvent. The presence of ammonium salts, organic acids, or their salts caused interference. Once the 8-hydroxyquinolate was formed, it remained extractable even at very low pH values. Stripping of ruthenium from the benzene extract was accomplished by contact with concentrated hydrochloric acid. This solvent extraction was applicable to the colorimetric determination of minute amounts of ruthenium and to the isolation of ruthenium activities in mixed fission products. (auth)

9259 STUDIES OF THE SYNTHETIC INORGANIC ION EXCHANGER. IV. THE SEPARATION OF THE FISSION PRODUCT AND URANIUM BY MEANS OF A STANNIC PHOSPHATE CATION EXCHANGER. Yasushi Inoue and Shin Suzuki (Tohoku Univ., Sendai). Bull. Chem. Soc. Japan, 37: 1547-53(Oct. 1964).

The separation of fission products and uranium was carried out by means of a stannic phosphate cation exchanger. By using various concentrations of nitric acid and ammonium chloride solutions as eluants, the separation of uranium from strontium and uranium from cesium was easily performed, but that of uranium from rare earths was difficult. Among the various reagents investigated, a 1M phosphoric acid solution was most suitable for the separation of uranium from rare earths. In view of these results, the separation of uranium and gross fission products was carried out; the resultant yield of uranium was more than 90%, and the decontamination factor was $(2{\sim}3) \times 10^3$. (auth)

9260 SEPARATION AND MEASUREMENT OF RADIOCERIUM IN RADIOACTIVE EFFLUENTS. J. Scheidhauer, L. Messainguiral, and N. Drogue. Chim. Anal. (Paris), 46: 567-71(Nov. 1964). (In French)

Two methods for determination of radiocerium are described. In one, utilizing a carrier, the cerium is precipitated as the oxalate after a series of decontaminations. In the second with no carrier, the cerium is chemically separated with lanthanum as the coprecipitant and extracted with 2-ethylhexylphosphoric acid. Cerium is finally deposited from hydrochloric acid solution on mylar and counted with a β counter. Utilization of an aluminum screen permits separation of ^{141}Ce and $^{144}Ce + {}^{144}Pr$. (tr-auth)

9261 THE EUROCHEMIC REPROCESSING PLANT AT MOL. PART I. R. O. R. Brooks. Euro Nucl., 1: 212-16 (Dec. 1964).

The equipment at Mol for processing irradiated fuel elements to remove plutonium produced during irradiation and the remaining uranium are described and details of the reprocessing flowsheet are given. Topics covered include: fuel reception and storage, cask and fuel element handling procedures, the reprocessing plant, extraction, safety control measures, analytical control, and storage of the final product. (M.C.G.)

9262 SPENT FUELS AND THEIR REPROCESSING FACILITIES. Takeshi Sakamoto (Nuclear Fuel Corp., Japan). Genshiryoku Hatsuden, 8: 16-23(Mar. 1964). (In Japanese)

Reprocessing of spent fuel from nuclear power stations is discussed. The necessity for reprocessing the spent fuel and problems arising in the reprocessing are considered. Descriptions of reprocessing facilities are given. (NSA of Japan)

9263 SELECTIVE ADSORPTION OF $PoCl_6^{2-}$ IONS BY IONIZED MONOMOLECULAR LAYERS OF A CATIONIC SURFACE AGENT. Yolande Hendrikx, Anne Luzzati, Lisbeth Ter-Minassian-Saraga (Faculté des Sciences, Paris). J. Chim. Phys., 61: 1351-3(Sept. 1964). (In French)

The selective adsorption of $PoCl_6^{2-}$ by ionized monomolecular layers of lauryltrimethylammonium bromide in 2N HCl solution was studied. The separation factor of the ions $PoCl_6^{2-}/Cl^-$ was calculated and its variation with the surface density of the bromide layer was studied. The high values found for the separation factor (of the order of 10^5) under conditions where the electric potential jump ought to be low (high ion power) seemed to indicate that under the given experimental conditions the effects of an electrostatic nature were of slight importance. The ion $PoCl_6^{2-}$ had a very preferential adsorption with respect to the Cl^- ion. (J.S.R.)

9264 EXTRACTION OF THORIUM BY ROTATING-DISC CONTACTOR. Shigeru Katsumata and Ichiro Yagi (Asahi Electro Chemical Co., Ltd., Tokyo). Kogyo Kagaku Zasshi, 66: 1754-5(Nov. 1963). (In Japanese)

The counter current extraction of Th by tri-butyl phosphate using a rotating-disc contactor which has two separate sections at the top and the bottom of the contactor was investigated. The efficiency at constant phase ratio appears to be a function of $[(N^3R^5)/(HD^2)]$ (N: rotor speed, R: diameter of rotor discs, H: compartment height, D: diameter of column), and it can be stated that in general the efficiency is not affected by scale-up. (auth)

9265 SEPARATIONS USING SOLVENT EXTRACTION. H. Green. Metallurgia, 70: 143-9(Sept. 1964).

A survey was made of useful solvent extraction separations. Bromide, chloride, fluoride, iodide, heteropoly acid, nitrate, thiocyanate, dye, acetylacetone, sodium diethyldithiocarbamate, diphenylthiocarbazone, 8-hydroxyquinoline, cupferron, 1-(2-pyridylazo)-2-naphthol, and 2-thenoyltrifluoroacetone extractions are described and their uses discussed. (M.C.G.)

9266 THIN-LAYER CHROMATOGRAPHY OF INORGANIC IONS. I. SEPARATION OF CATIONS. P. Markl and F. Hecht (Universität, Vienna). Mikrochim. Ichnoanal. Acta, No. 5-6, 889-94(1963). (In German)

By means of a number of model trials it was shown that thin-layer chromatographic separations can be made by means of triisooctylamine as carrier. An ion with a high distribution coefficient can be selectively isolated from a mixture of ions with low distribution coefficients. Illustrative examples include the selective separation of U^{6+} or Mo^{6+} from a mixture with Fe, Ni, Co, and Zn, in nitric acid solution or of Fe^{3+} from a mixture of Ni^{2+}, Mn^{2+}, and Fe^{3+}. (auth)

9267 THIN-LAYER CHROMATOGRAPHY OF INORGANIC IONS. [PART] II. P. Markl and F. Hecht (Universität, Vienna). Mikrochim. Ichnoanal. Acta, No. 5-6, 970-5(1963). (In German)

It was shown that impregnation of a thin layer with a complex-forming compound yields the properties of an exchange layer on which chromatographic separations can then be accomplished by the technique of exchanger papers. In comparison with working with exchanger papers, the separation time is usually shorter and the capacity is higher. This method can be adapted to other problems by using other complexing agents. It may possibly also be employed for separations in the examination of irradiated uranium nuclear fuel. (auth)

9268 CHROMATOGRAPHIC SEPARATION OF URANIUM FROM AQUEOUS SOLUTIONS ON PAPER AND CELLULOSE. E. Hayek and H. Dalla Torre (Universität, Innsbruck). Mikrochim. Ichnoanal. Acta, No. 5-6, 1078-81 (1963). (In German)

On the basis of formation of the carbonato complex, it is possible to separate uranium(VI) in aqueous solution in amounts from 0.1 to 10 μg on chromatographic paper and in amounts from 0.1 to 10 μg on cellulose columns from all di- and polyvalent cations. (auth)

9269 STUDY ON THE TECHNETIUM(IV) DISTRIBUTION BETWEEN TRI-n-OCTYLAMINE AND AQUEOUS THIOCYANATE SOLUTION. Yoshinaga Oka and Toyoaki Kato (Tohoku Univ., Sendai, Japan). Nippon Kagaku Zasshi, 85: 784-7(Nov. 1964). (In Japanese)

A study was made of the distribution of technetium between tri-n-octylamine(TNOA) in cyclohexane and aqueous thiocyanate solution was carried out using ^{99m}Tc in an attempt to determine the thiocyanate complex species of technetium present in thiocyanate solution. The effects of concentrations of aqueous acid, thiocyanate and, TNOA in cyclohexane on distribution ratios of technetium led to the conclusion that the Tc(VII), initially contained in aqueous solution, was reduced to Tc(IV) and formed its thiocyanate complex defined as $Tc(NCS)_6^{2-}$. The technetium species predominating in the amine phase was shown to be $R_2Tc(NCS)_6$, where R referred to the amine matrix, $(C_8H_{17})_3NH^+$. The equilibrium constant for the reaction $RNCS + ClO_4^- \rightleftharpoons RClO_4 + NCS^-$ was also determined to be K = 0.45(22°C) by equilibrating aqueous $NaNCS$–$NaClO_4$-0.2 mol/l HNCS solutions ($\mu = 3.67$) with 7.6×10^{-3} mol/l TNOA in cyclohexane. (auth)

9270 ANION EXCHANGE SEPARATION OF RHENIUM AND TUNGSTEN. Kazuaki Kawabuchi (Ehime Univ., Matsuyama-shi, Japan). Nippon Kagaku Zasshi, 85: 787-9 (Nov. 1964). (In Japanese)

An anion exchange chromatographic procedure was developed for separating Re(VII) and W(VI) in ammonium thiocyanate/chloride media. An equilibrium study showed that the difference in the equilibrium distribution coefficient is sufficient for a good separation. W(VI) was strongly adsorbed on the top of the resin bed from 0.5 mol/l NH_4SCN-0.5 mol/l HCl medium, while Re(VII) was eluted easily from the column by the same eluent. W(VI) was stripped by eluting with 0.5 mol/l NaCl-0.5 mol/l NaOH solution. Microgram to milligram quantities of Re(VII) could be quantitatively separated from W(VI) in proportion of W : Re = 1000 : 1 to 1 : 300. The procedure can be successfully applied to the analysis of W–Re alloys for their constituents. (auth)

9271 PRESENT STATUS OF THE TRIAL EXTRACTION OF URANIUM ORE AT NINGYÔ-TÔGE (PASS). Hidekatsu Misawa, Hiroshi Setoguchi, and Yûkichi Kobayashi. Nippon Kogyo Kaishi, 79: 573-8(1963). (In Japanese)

Investigations were made on the feasibilities of industrial scale ore extraction by prospecting drifts on the basis of surface conditions. Various mining methods were examined. The prime uranium mineral of the Ningyô-tôge deposit is ningyonite located in unoxidized ore zones, which are in the pebble matrix in conglomerates. This mineral can easily be washed for concentration. Room-and-pillar mining methods and longwall mining methods using steel props and caps, which are normally used in coal mines, were applied to the stoping of weak conglomerate rocks. In order to reduce the mining costs, hydraulic mining methods were tried. For processing low grade ores, a washing plant with a capacity of 30 tons of ore per day was put in operation at Ningyô-tôge. (auth)

9272 ELEMENTARY EXPERIMENTS CONCERNING THE APPLICATION OF HYDRAULIC MINING TO THE URANIFEROUS SEDIMENTARY DEPOSITS. Keiji Doi and Hideo Sonoda. Nippon Kogyo Kaishi, 79: 579-84(1963). (In Japanese)

Mining experiments were carried out to establish the most efficient mining methods for sedimentary uranium deposits, which are important natural resources in Japan. The high efficiency, low cost, and washing effects on sedimentary uraniferous conglomerates of hydraulic mining were observed. Basic experiments were made on transportation by trough and pipe of ore samples from the Ningyô-tôge mine. Field experiments on hydraulic mining were carried out at the Ningyô-tôge mine. Cutting could be made by water jets with a central pressure of 7.5 kg/cm^2. If the pressure was more than 7.5 kg/cm^2, the depth cut increased until the pressure decreased to 7.5 kg/cm^2. In case of transportation by trough, an inclination more than 5° was necessary if the weight ratio of ore to water was $^1/_4$. There was almost no difference in transportation capacity even if other sizes of ore particles were fed. In case of transportation by pipe the following relation was found if ores less than 25mm in diameter were transported, using 80.7 mmϕ pipe: $h - h_0 = c/v^{0.325}$ where h is head loss in the horizontal pipe in case of ore transportation, cmH_2O/m; h_0 is head loss in the horizontal pipe in case of water transportation at the same velocity; c is volume density, %; and v is velocity, m/sec. The washing effect of water jets on the ore was unsatisfactory contrary to the expectation because of the small experiment scale. But the washing effect during transportation by pipe was found to be fairly good. (auth)

9273 AN EXPERIMENT ON WET SCREENING OF SEDIMENTARY URANIUM ORE AT NINGYÔ-TÔGE MINE. Mitsuaki Kajiyoshi and Kyoichi Kamio. Nippon Kogyo Kaishi, 79: 600-3(1963). (In Japanese)

Uranium deposits in the Ningyô-tôge area occur in the bottom of the Ningyô-tôge formation in Tertiary resting unconformably on granite, which spreads over Chûgoku district. Uranium minerals of the deposit occur mainly in arkose sandstone or porous matrices of conglomerate, coating surfaces and filling the cracks of various pebbles of the conglomerate. The uranium grade of fine matrices was higher than that of pebbles. Possibilities of concentrating the ore and reducing the ore feed for mill by collecting fine matrices by washing and screening are discussed. An experiment using washing and screening was carried out on ores of the oxidized and unoxidized zones of the Tôge deposit. The experiment was more effective on the unoxidized ore. When the slime passing through 0.15-mm dia screen was collected, the uranium grade of concentrate was increased as much as 6.7 times that of crude ore, the ratio of concentration became 9.3 and the recovery percentage of U_3O_8 was 71.4% on an average out of 25 samples. (auth)

9274 SEPARATION OF TUNGSTEN AND MOLYBDENUM FROM W–Mo MIXED COMPOUNDS. Motichi Harada. Nippon Kogyo Kaishi, 79: 499-502(July 1963). (In Japanese)

In the process of W chemical refining, Mo impurities such as powellite in scheelite-concentrates have been removed as MoS_3. These MoS_3-precipitates occlude significant amounts of WO_3 and the autoclave-sodium polysulfide process was developed for the separation of them. W and Mo components in the precipitates were converted to Na salts and then digested with Na_2S_x in an autoclave. Mo remained as sodium thiomolybdate in Na extracts and could be recovered as Mo-sulfide precipitate by adjusting the pH of the solution. W was recovered as $CaWO_4$ by the reaction with $Ca(OH)_2$ from Na extracts. Resulting Mo products were very pure and W products contained a little Mo. (auth)

9275 APPLICATION OF CO-CRYSTALLISATION TECHNIQUE FOR THE PRODUCTION OF CARRIER FREE SILVER-111 FROM PILE IRRADIATED PALLADIUM. N. B. Micheev, A. A. Abdel-Rassoul, and H. Fouad (Atomic Energy Establishment, Inchass, Egypt). Z. Anorg. Allgem. Chem., 332: 209-15(Oct. 1964).

Carrier free ^{111}Ag was separated from neutron-irradiated palladium targets by the combined crystallization and electrodeposition techniques. Co-crystallization coefficient measurements of silver activity on NaCl were performed, and the best conditions for the separation of ^{111}Ag in more than 90% yield were used. The method requires no consumption of special chemicals and makes the quantitative separation and subsequent use of irradiated palladium possible. Purification of the target before irradiation by solvent extraction eliminated radiochemical impurities expected from trace metals in the original target, particularly gold and silver. The product separated proved to be of high chemical and radiochemical purity. (auth)

9276 KINETICS OF RARE EARTH SORPTION ON WEAK SOLUTION CATIONITES. M. E. Kornelli and I. A. Legenchenko. p.24-9 of "Issledovanie Svoistv Ionoobmennykh Materialov." Moscow, Izdatel'stvo "Nauka," 1964. (In Russian)

The rate of rare earth cation sorption was studied with La, Nd, and Gd cations and H^+, Na^+, and NH_4^+ resins. Under identical conditions the rate constants for La^{3+}, Nd^{3+}, and Gd^{3+} sorption on the same resin were identical; with different resins the rate constants were reduced according to the following sequence: $HR \rightarrow NaR \rightarrow NH_4R$. A 10°C increase in temperature increased the rate of the process only 1.2 to 1.4 times. (R.V.J.)

9277 THE OREGON STATE CONTINUOUS COUNTER CURRENT ION EXCHANGER. Walter Meyer and Richard S. Olsen (Oregon State Univ., Corvallis). 39p. (CONF-606-4)

From American Chemical Society Northwest Regional Meeting, Spokane, Wash., June 1964.

The design and operation of a continuous counter-current ion exchange system of the downward resin flow type is presented. Operated in a multiple column scheme the exchanger is applicable to the recovery of multiple products from a single feed stream. Single column operation is particularly applicable to the recovery of fissionable materials and to the recovery and purification of materials by ion retardation or ion exclusion. Operating data are presented and interpreted. (H.D.R.)

9278 SEPARATION OF RADIOCHEMICALLY PURE TELLURIUM BY SOLVENT EXTRACTION. B. Z. Iofa. Russian Patent 164,252.

A solvent extraction method of separating ^{125m}Te from Sb by reextracting ^{125m}Te from an Sb solution in n-dibutyl ether by using at least 8 to 9 M chlorine-saturated hydrochloric acid. (auth)

ENGINEERING

General

Refer also to abstract 10032.

9279 (AERE-R-4748) A PULSED ARC FOR THE STUDY OF THERMAL SHOCK. R. C. McVickers and R. A. Dugdale (Unite Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1964. 29p. $1.00(BIS), 5s. (HMSO).

In the study of controlled thermonuclear reactions, the walls of the experimental chambers may be subject to sudden heat fluxes of short duration. The thermal stresses so induced may cause cracking and flaking of the walls and there is a need to study the effects produced by this type of stressing. In addition it is desirable to make a quantitative study so that temperature distributions and resulting stresses can be calculated and correlated with wall damage. A low-pressure pulsed carbon arc is described which gives transient heat fluxes sufficiently intense to produce surface damage on ceramic materials. To achieve an accurate and convenient waveform with simple equipment, an exponetial heat pulse waveform was chosen. The time constant is 425 μsec and peak power loadings from 10 to 70 $\mathrm{kw/cm^2}$ can be achieved. The heat pulses delivered to a specimen placed in the arc vary slightly with position. An experimental study of peak surface temperatures on various specimens in a specified position is used to calibrate the heat fluxes. Thus by selecting the operating condition for the arc and using the calibration it should be possible to estimate peak surface temperatures to within ± 10% for a specimen of any material for which the relevant thermal constants are known. The arc characteristics are described. Radiation densities have been measured with a thermopile and the spectral distribution in the visible region has been examined. It is concluded that heating of a specimen due to absorption of radiation will be small compared with that by conduction from the plasma. Due to contamination from the electrodes, the arc is mainly suitable for operation in air at a pressure of 1.0 torr but it has also been used regularly at 5×10^{-2} torr at low operating voltages. Modifications are suggested to give satisfactory operation with other gases. An R–C analog service is described which simulates heat flow by conduction. Curves, obtained from the analog, are given and these allow the calculation of the temperature distribution within a specimen in depth and time. (auth)

9280 (DP-920) NONDESTRUCTIVE TEST OF CARBON BEDS FOR REACTOR CONTAINMENT APPLICATIONS. Progress Report, April–June 1964. David R. Muhlbaier (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1964. Contract AT(07-2)-1. 10p. Dep.; $1.00 (OTS).

A standardized nondestructive and more generally applicable test for installed carbon beds that are used in reactor containment facilities is being developed by the Savannah River Laboratory. Continuing tests show that the permissible ranges of air velocity and H_2O content of the carbon are increased significantly by substituting "F-11" or "F-114B2" for "F-12"—a more volatile "Freon" that was used in an earlier testing method. (auth)

9281 (IS-900(Sect. E) ENGINEERING DIVISION. (Ames Lab., Ames, Iowa). 51p.

Research and development are reported on chemical engineering, ceramic engineering, nuclear engineering, and mechanical engineering. (J.R.D.)

9282 (LAMS-3083) A DIGITAL COMPUTER METHOD FOR DESIGN AND ANALYSIS OF AXISYMMETRIC THIN SHELLS SUBJECTED TO PRESSURE AND THERMAL ENVIRONMENTS. J. W. Neudecker (Los Alamos Scientific Lab., N. Mex.). Apr. 1, 1964. Contract W-7405-eng-36. 219p. Dep.; $6.00(OTS).

A study was carried out for the purpose of developing methods for analyzing for the stresses, deflections, and rotations induced in the pressure vessels of the Kiwi-B series nuclear rocket reactors. The analysis methods presented in this design study are considered to be generally applicable to all similar pressure vessel and nozzle applications, and these methods are considered to be the minimum analysis necessary to substantiate the structural adequacy of all future Kiwi series reactor pressure vessels and nozzles. Emphasis is placed on the use of machine computational methods for analyzing the pressure vessels for both static test and operating conditions. A brief history is presented of the pressure vessel development problems of Rover project reactors, and continuing problems of maintaining structural compatibility of pressure vessels and nozzles are discussed. Results of design calculations and experiments for static test conditions are presented. (auth)

9283 (LGI-63/23) ON THE CONTAINMENT OF EXPLOSIONS. F. Herlach and H. Knoepfel (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). Nov. 1963. 25p. Dep.(mn)

A review is presented on shock pulses from detonation, behavior of a vessel subjected to a large radial impact, and static containment and pressures. Some strain measurements were made using annular explosive charges. It is concluded that for high explosives of energy density ~ 5 kJ/g, the criterion for safe containment is either $M(\text{container}) \geq 1000M(\text{explosive})$ or $M(\text{container}) \geq 0.2E(\text{explosive})$, where M = mass in tons and E = energy in MJ. (D.L.C.)

9284 (ORNL-3664) VACUUM LEAK TESTING OF RADIOACTIVE SOURCE CAPSULES. C. R. King (Oak Ridge National Lab., Tenn.). Jan. 1965. Contract W-7405-eng-26. 11p. Dep.; $1.00(OTS)

A procedure was developed for detecting leaks smaller than 0.1 μ dia in radioactive source capsules. The capsule is immersed in isopropyl alcohol and a vacuum created above the alcohol to produce bubbling from container leaks. The limit of leak detection over the range studied is dependent on the differential pressure, the surface tension of the liquid, and the leak diameter. Whereas leaks down to 0.7 μ dia can be detected by conventional vacuum leak testing without pressurization of the capsule, pressurization to about 125 psig prior to actual testing permits the detection of leaks from openings smaller than 0.1 μ dia. This study revealed no limit to the leak-test sensitivity. (auth)

9285 (RTD-TDR-63-3116) A STUDY OF THE BEHAVIOR OF A CLAY UNDER RAPID AND DYNAMIC LOADING IN THE ONE-DIMENSIONAL AND TRIAXIAL TESTS. Final Report. H. Kane, M. T. Davisson, R. E. Oleson, and G. K. Sinnamon (Illinois. Univ., Urbana). June 1964. Contract AF29(601)-5535. 296p. (AD-602738) $6.00(OTS).

The behavior of soil under dynamic loading is an important factor in the soil-structure interaction problem. To study this behavior, a series of dynamic, high-pressure triaxial, and one-dimensional compression tests has been conducted. Special testing devices developed for this research are described. In the one-dimensional tests, the peak pressures ranged from 620 to 11,300 psi with rise times to the peak pressure of 1.9 to 1,625 milliseconds. In the triaxial tests, cell pressure from 100 to 1,010 psi were used with times-to-failure varying from 3 msec to 100 seconds. In addition, partial loading triaxial tests were run in which the applied axial stress was 20 to 60 percent of the failure stress. The soil used was a compacted silty clay of low plasticity. The test results are presented and the influence of rate of loading and pressure level on compressive strength, ratio of lateral to axial pressures, stress-strain relations, residual strains, and creep under constant load are evaluated. (auth).

9286 (TID-4101(Rev.1) ENGINEERING MATERIALS LIST CUMULATIVE DRAWING NUMBER INDEX THROUGH

SUPPLEMENT 24. Richard E. C. Duthie, ed. (Division of Technical Information Extension, AEC). Dec. 1964. 164p. Dep.

A cumulative index is presented of all CAPE numbers assigned to engineering drawings and specifications that have been announced in the Engineering Materials List (TID-4100) and Supplements 1 through 24. (D.L.C.)

9287 (URS-639-4) STRUCTURAL DEBRIS CAUSED BY NUCLEAR BLAST. Research Report, October 1964. J. E. Edmunds, C. K. Wiehle, and K. Kaplan (URS Corp., Burlingame, Calif.). Contract OCD-PS-64-19. 76p. (AD-450115)

Methods were developed for predicting the quantity of structural debris produced by air blast from various types of nuclear weapon attack. Detailed analyses were made of reports of situations that resulted in the production of debris, in particular the attacks on Hiroshima and Nagasaki and those Nevada Test Site and Pacific nuclear weapons tests in which structural damage was observed. In general it was not found possible to base quantitative estimates of debris on existing analyses of damage, since structural damage and the debris produced as a result of the damage are not necessarily related. Instead it was necessary, in all cases, to make new estimates of both the quantities of material contained in various elements of structures (roof, wall, floors, frame, etc.) and the portions of these materials that became debris. The first curves developed for estimating debris quantities as functions of incident air blast overpressure level were for kiloton-range weapons. However, analysis of the influence of the longer overpressure durations from megaton-range weapons on structural behavior permitted the development of curves predicting debris quantities for these weapons. Debris quantities as a percentage of total building materials produced by various air blast overpressures from both kiloton- and megaton-range weapons are plotted for six classes of structures (light and heavy industrial, ordinary and aseismic design steel and reinforced concrete frame, wooden, and brick or masonry). (D.L.C.)

9288 (WAPD-T-1636) THE LIMIT PRESSURE OF RADIAL NOZZLES IN SPHERICAL SHELLS. R. L. Cloud (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1964. Contract AT-11-1-GEN-14. 34p. (CONF-763-43). Dep.(mn); $2.00(cy), 1(mn) OTS.

From American Society of Mechanical Engineers Winter Meeting, New York, Nov.-Dec. 1964.

The limit pressure has been calculated approximately for a cylindrical nozzle in a plain spherical shell and also for a pad reinforced shell. It is shown how the results may be used in the design of reinforcements for nozzles. Tests were run to confirm the validity of the analysis and good agreement was found. (auth)

9289 (WL-TDR-64-53) A STUDY OF THE FEASIBILITY OF SHOCK ISOLATING VERY LARGE MANNED UNDERGROUND STRUCTURES. H. R. Saffell, J. G. Ved, and L. S. Thomas (Parsons (Ralph M.) Co., Pasadena, Calif.). June 1964. Contract AF29(601)-6053. 377p. (AD-602764). $7.00(OTS).

The feasibility of shock-isolating very large manned underground structures from the intense ground motions generated by a nuclear blast was investigated. The structure under consideration housed personnel living quarters, and communications and survival equipment, including large liquid-filled tanks, and was suspended within a concrete-lined underground cavity. Various suspension configurations, isolators, and damping devices were investigated and their performance characteristics compared with the specific requirements of this facility. It is concluded that an inclined, elastic, pendular suspension system incorporating fluid-filled isolators and force-limited dampers provides satisfactory control over the body motions without exceeding acceptable accelerations. Conventional cage structure and liquid storage techniques are found to be acceptable if careful attention is given to their design. (auth)

9290 (Y-1479) AN ANALYSIS OF THE REQUEST, PROCUREMENT, AND DELIVERY OF MATERIALS, SUPPLIES, AND EQUIPMENT FOR A MAINTENANCE ORGANIZATION. D. R. Sampson (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). Dec. 1, 1964. Contract W-7405-eng-26. 130p. Dep.; $4.00 (OTS).

Thesis submitted to Univ. of Tennessee, Knoxville.

The problem was to analyze and present in simplified form the methods used in obtaining materials, supplies, and equipment for a maintenance organization. The methods employed are presented in a generalized manner to provide a guide to others, if desired, and to provide a graphic presentation to allow for periodic review of the total system. The procedures employed by the Y-12 Maintenance organization were analyzed. Various industrial engineering techniques were utilized to analyze these methods and procedures to consolidate the over-all program into a workable system. The results of these efforts are that the system is depicted in simplified understandable form. This analysis has afforded maintenance management with a summary of the system that allows adequate followup to analyze any deviation from the established procedures. (D.L.C.)

9291 1-KW ARCJET-ENGINE SYSTEM-PERFORMANCE TEST. Adriano C. Ducati, Harold Humpal, Joseph Meltzer, Erich Muehlberger, James P. Todd, and Herman Waltzer (Giannini Scientific Corp., Santa Ana, Calif.). J. Spacecraft Rockets, 1: 327-32(May-June 1964).

A 1-kw d-c arcjet-engine system, with power conditioning equipment and a cryogenic hydrogen propellant storage unit, was tested at an environmental pressure of 8×10^{-5} mm of mercury. This radiation-cooled arcjet engine was designed to operate at approximately 1000-sec specific impulse. Current, voltage, propellant flow rate, thrust, chamber pressure, and body temperatures were measured continuously. Engine efficiencies (10-30%) and specific impulses (600-1400 sec) were deduced from the data, but reliability of the thrust measurements was poor. The exhaust plume was photographed with high-speed infrared film and various filters to reveal the size, turning angle, and shape of various wavelength regions. Plume radiation was measured by a radiometer with identical filters to determine the spectral distribution. (auth)

9292 EXPERIMENTAL STUDIES OF THE PERFORMANCE OF LONG-LIVED MHD DUCTS. W. F. S. Bugden, L. A. Green, J. Maycock, P. G. Meier, D. T. Swift-Hook, and J. K. Wright (Central Electricity Generating Board, Leatherhead, Surrey, Eng.). 12p. (CONF-640701-79)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

It is noted that previous work on magnetohydrodynamic (MHD) ducts revealed that cooled surfaces can be used. To further investigate the performance of water-cooled metal tubes, a duct 6.4 cm^2 in area by 7 cm long was constructed and used in long-duration and applied-voltage experiments. Another tube was constructed that was 32 cm^2 area by 50 cm long for generation experiments. Results of experiments with applied voltages and generation investigations are given. (J.R.D.)

Applications of Nuclear Explosions

9293 (UCRL-6999(Rev.II)) CRATERING AND RADIOACTIVITY RESULTS FROM A NUCLEAR CRATERING DETONATION IN BASALT. M. D. Nordyke and W. Wray (California. Univ., Livermore. Lawrence Radiation Lab.). Oct. 10, 1963. Contract W-7405-eng-48. 37p. Dep.(mn); $2.00(cy), 1(mn) OTS.

A summary of the cratering and radioactivity release data from project Danny Boy, a recent 420-ton nuclear cratering detonation in basalt, is presented. The detonation was at a depth of 33.5 m and produced a crater about 32.5 m in radius and 19 m deep. Comparison of the crater results with past cratering experience in basalt shows that the Danny Boy crater agrees with these data, using $W^{1/3.4}$ scaling and an equivalence between chemical and nuclear explosives. Integration of the fallout pattern shows that about 4 per cent of the radioactivity produced in the explosion escaped from the crater and appeared as fallout. The disposition of the radioactivity in the crater area and in the fallout pattern is given. On the basis of the above results, it is concluded that both the cratering results and the radioactivity release results are well within predictions made before the event. (auth)

9294 (UCRL-12180) AGGREGATE PRODUCTION WITH NUCLEAR EXPLOSIVES. Spenst M. Hansen and John Toman (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 20, 1964. Contract W-7405-eng-48. 34p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Breaking rock for the manufacture of crushed stone aggregate is one possible use of nuclear explosions. A family of curves is given for the tonnage of broken rock as a function of yield and depth of burst. Experimental results of the Pre-Schooner Charlie, Neptune, and Danny Boy events are discussed. Engineering considerations and site selection for aggregate production are discussed. Finally, costs and safety considerations are given. (D.L.C.)

9295 (UCRL-12248) PROGRESS IN NUCLEAR EXCAVATION TECHNOLOGY. Milo D. Nordyke and Louis J. Circeo (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 12, 1964. Contract W-7405-eng-48. 28p. (CONF-650102-1). Dep.(mn); $2.00(cy), 1(mn) OTS.

From Highway Research Board 44th Annual Meeting, Washington, D. C.

A large quantity of cratering data has been obtained over the past 13 years in a number of media. One medium in particular, NTS desert alluvium, has been exhaustively explored with both chemical explosive point charges, nuclear point charges, and chemical explosive row charges. One other medium, basalt, has been explored to a lesser extent with large-yield chemical-explosive charges, and cratering curves have been determined. These two media, in general, are expected to bracket most types of media to be encountered in nature; therefore, the range of crater dimensions to be expected for many nuclear excavation projects will, in all probability, fall between these two types of media. The Dugout experiment, the first row-charge cratering experiment in hard rock, indicates that many of the concepts developed for row charges in alluvium are also valid in a hard-rock medium. Two investigations into the survival of craters under the action of natural and dynamic forces indicate that craters are not severely affected by wave and water action over long periods and that cratered slopes can survive large seismic forces without experiencing serious slope failures. A theoretical model of explosive cratering is being developed, based on a hydroelastic-plastic model and a late-phase gas acceleration model. Results to date are very encouraging and indicate an ability to duplicate both observed surface motions and empirical crater dimension curves for alluvium. Nuclear excavation costs in hard rock are estimated to be competitive with conventional excavation in the 10-kiloton range, rapidly decreasing to a few cents per cubic yard in the megaton range. Advancement in the development of low-fission thermonuclear explosives in the near future is expected to reduce radioactivity levels 100-fold below 1962 Sedan levels. (auth)

9296 (UCRL-Trans-1108(L)) ROAR OF PEACEFUL EXPLOSIONS. M. Sitii (Sytyi). Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore), from Nauka i Zhittya, 12: 43-(1962). 4p. Dep.(mn); $1.00(cy), 1(mn) OTS; $1.10(fs), $0.80(mf) JCL.

A popular-type article is presented on the use of explosions to dry up swamp lands and to create artificial water basins. (D.L.C.)

9297 NUCLEAR ENERGY FOR PEACEFUL USES WITH PARTICULAR REFERENCE TO THE MINING INDUSTRY. Tullio Seguiti. Ind. Mineraria (Rome), 15: 304-13(1964). (In Italian)

The uses of nuclear explosions for peaceful purposes are discussed. The availability of energy in the world was first considered. Tests and studies by the US and other countries on the peaceful utilization of nuclear energy are summarized. The factors to be considered in the evaluation of nuclear explosions for peaceful purposes are outlined, and the precautions to be taken against various dangers are given. The possible applications of such explosions to the mining industry are described. (J.S.R.)

9298 SPALLING OF THE EARTH'S SURFACE BY UNDERGROUND NUCLEAR EXPLOSIONS. J. D. Eisler (Stanford Research Inst., Menlo Park, Calif.) and F. Chilton. J. Geophys. Res., 69: 5285-93(Dec. 15, 1964).

Spalling of the near-surface earth layers caused by contained underground shots detonated in tuff, granite, halite, and alluvium was investigated. From the arrival-time data obtained from surface accelerometers, certain aspects of the kinematics of spalling were deduced by means of simple ballistic and plastic-diaphragm concepts. It was shown that the shape of the spall gap is conical with sides concave upward (the shape of a coolie hat) and not a dome as is commonly supposed. From the arrival-time data it was possible to estimate the radial extent of the spall and to compute the thickness of the spalled layer at ground zero. The maximum width of the spall gap at ground zero was smaller than the surface displacement at that point, indicating the existence of additional spall gaps at other depths and perhaps fluffing of the surface formation under the action of spalling forces. (auth)

Facilities and Equipment

Refer also to abstracts 9829, 10189, 10468, 10551, and 10625.

9299 (ACNP-64030) STEAM SEPARATION TECHNOLOGY UNDER THE EURATOM PROGRAM. Quarterly Progress Report, October 1, 1964–December 31, 1964. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). Jan. 11, 1965. Work Performed under United States–Euratom Joint Research and Development Program Contract AT(11-1)-1186. 62p. (EURAEC-1286). Dep. (mn); $3.00(cy), 2(mn) OTS.

The design and construction of a 10-inch diameter upcomer separator test model and the other necessary test internals for the high-pressure steam-water loop have been completed. Testing of the horizontal separator continued with improvements being made in the areas of carryunder and pressure drop. Testing of the 360-degree hooded crossover in the high-pressure steam-water loop has been completed. Results show that the separator gives some definite improvement to the carryunder problem. The chevron type dryer has been tested over the pressure range of 600 to 1800 psi. Release rate break points as well as absolute quality values in the threshold region were obtained for all pressures. The mesh type dryer has been installed and testing is in progress. (auth)

9300 (ANL-6934) INTERBUILDING FUEL TRANSFER COFFIN FOR THE EBR-II REACTOR. G. J. Bernstein, A. A. Chilenskas, and R. F. Malecha (Argonne National Lab., Ill.). Sept. 1964. Contract W-31-109-eng-38. 21p. Dep.; $2.00 (OTS).

A 20-ton, portable, lead-shielded coffin has been built to transfer spent fuel subassemblies from the EBR-II Reactor to the adjoining Fuel Cycle Facility for processing. Fission-product heat of about 1 kw is removed by a circulating gas stream which is driven by an attached battery-powered blower. An internal heat exchanger transfers the heat from the coolant gas to the lead shielding. Provision is made for removing a coating of sodium from the fuel subassembly while it is within the coffin. The principal design features and operations are described. (auth)

9301 (ANL-6966) DESIGN OF A REMOTELY REMOVABLE AND REPLACEABLE CRANE-BRIDGE DRIVE UNIT FOR THE EBR-II FUEL CYCLE FACILITY. Johan E. A. Graae (Argonne National Lab., Ill.). Nov. 1964. Contract W-31-109-eng-38. 18p. Dep.; $1.00(OTS).

A remotely replaceable bridge drive unit with gear motor and electromagnetic clutch was developed for driving remotely controlled travelling crane bridges in the EBR-II Fuel Cycle Facility. The cranes are located inside a gas-tight, circular cell, provided with an argon atmosphere. The cell is intended for processing nuclear fuel after use in the reactor, so the radiation background will be very high. For these reasons the drive unit must be remotely replaceable and maintainable, and protected against radiation. The design was severely restricted by the rather inaccessible location and the equipment provided for removal. It was also necessary to design within the space limitations of an originally furnished drive unit which proved inadequate. A special novel locating pin system was developed for precise installation of the drive unit by remote means. (auth)

9302 (CEA-R-2498) CANAUX CHAUFFANTS A HAUT FLUX THERMIQUE POUR BOUCLES A LIQUIDES ORGANIQUES SOUS IRRADIATIONS. (Heating Channels of High Thermal Flux for Liquid Organic Loops Under Irradiation). André Teytu (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Grenoble). Oct. 1964. 30p. Dep.(mn)

Heating elements described in the report are heated by direct or alternating current in the wall cooled by the liquid. The element temperature can be 500°C and the heat flux in the test section 100 watt/cm^2. The type of heating element used in a loop working under an accelerator is supplied by a low-voltage high current (1500 amp). This type is relatively simple, robust and convenient for experiments. When the heating element is used in loop near the core of a research reactor, it is supplied with a lower current (750 amps). This type is more complicated and fragile due to the conditions of working and the safety device necessary for a reactor. The heating stainless steel pipe has an outside diameter of 20 mm and a thickness of 0.15 mm. Presented are the elements of calculation for this heating element, a description of the two types built, and a report of tests made on a technological test loop. (auth)

9303 (CERN-64-50) SOME STUDIES OF HIGH VOLTAGE VACUUM BREAKDOWN ACROSS LARGE GAPS. INVESTIGATIONS OF THE PROPERTIES OF OXIDE-COATED ALUMINUM ELECTRODES. APPLICATION TO ELECTROSTATIC SEPARATORS. Francois Rohrbach (European Organization for Nuclear Research, Geneva). Nov. 9, 1964. 41p. Dep.(mn).

D-c high voltage breakdown tests across large gaps (1 to 10 cm) have been performed in the pressure range 10^{-6} to 10^{-3} torr with different types of electrodes, namely glass and oxide-coated aluminum as cathodes, and aluminum and stainless steel as anodes. Small electrodes (300 cm^2) and large electrodes (15000 cm^2) were tested in two different vacuum tanks. Electric fields well above 100 kv/cm have been maintained even with the large electrodes and after a very large number of sparks. Further fundamental theoretical investigations have been carried out in order to try to understand the influence of the pressure on the vacuum breakdown voltage. (auth)

9304 (DP-922) A BASIN FACILITY FOR EXAMINING IRRADIATED NUCLEAR FUEL. Frederick C. Locke (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Oct. 1964. Contract AT(07-2)-1. 23p. Dep.; $2.00(OTS).

The SRL Room of the Receiving Basin for Off-Site Fuels facility at the Savannah River Plant provides equipment for disassembling and inspecting irradiated nuclear fuels in two water-filled basins. The Disassembly Basin is used for horizontal disassembly of sound or failed fuel assemblies and for cutting and other operations that expose bare fuel to the basin water. The Inspection Basin has equipment for vertically disassembling and nondestructively examining fuel elements. Contamination of the deionized basin water is controlled by a purge flow that can be pumped to either of three disposal systems according to the water activity. (auth)

9305 (DP-931) A PERISCOPE FOR VIEWING AND PHOTOGRAPHING RADIOACTIVE OBJECTS UNDERWATER. Frederick C. Locke (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1964. Contract AT(07-2)-1. 10p. Dep.; $1.00(OTS)

A periscope was developed for inspecting and photographing irradiated fuel elements in a water-filled basin. The periscope is low in cost and offers ease of maintenance on account of its above-water placement of all precision optical components. (D.L.C.)

9306 (HW-84084) RECOMMENDED CHANGES TO THE 234-5 BUILDING ANALYTICAL LABORATORY VENTILATION SYSTEM. M. E. Borgeson (General Electric Co. Hanford Atomic Products Operation Richland, Wash.). Aug. 20, 1964. Contract AT(45-1)-1350. 12p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Work diversification has made it necessary to increase the number of operations completed in glove boxes, to increase the inventory of stored plutonium, and to perform some non-routine work such as the preparation of special request plutonium compounds. Changes in the Laboratory exhaust ventilation system are necessary to reduce the probability of releasing contamination to the outside environs. These changes involve taking the gravity exhaust system out of service and re-routing the room exhaust so it passes through the filter rooms, thus providing air decontamination by filtration through high efficiency filters. A preliminary cost estimate for making the changes is $40,000. This estimate is based upon blanking each gravity exhaust duct at its outlet on the roof, and making minor modifications to those which are to be adapted to the new system. Removal of all gravity exhaust ducts not used would cost an additional $10,000, which would bring the total estimate to $50,000. (auth)

9307 (IDO-17032) TAN HOT SHOP AND SATELLITE FACILITIES. R. A. Freeman, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Nov. 1964. Contract AT(10-1)-205. 89p. Dep.(mn); $3.00(cy), 1(mn) OTS.

This hot shop manual is presented as a reference book for engineers at the NRTS and as a design aid for manufacturers who produce equipment requiring remote handling. A successful design for hot shop manipulation requires a minimum of handling and requires simple, rugged subassemblies with large, accessible fasteners. Guides and dowels should be provided with well tapered leads. Designers should bear in mind that, at best, hot shop manipulation is a slow, expensive operation. Any measures taken in designing in order to simplify remote handling are well worthwhile. (auth)

9308 (IPP-4/8) MAGNETFELDER DER SPULEN, Sp 182, Sp 300, Sp 440, Sp 100/13. KURVEN UND TABELLEN. (Magnetic Fields of the Coils Sp 182, Sp 300, Sp 440, and Sp 100/13. Curves and Tables). P. Krueger (Institut für Plasmaphysik, G.m.b.H., Garching, Germany). Feb. 1964. 21p. Dep.(mn).

The axial and radial components of the magnetic field strengths were plotted as functions of position. The results are shown in tabular and graphic form. (J.S.R.)

9309 (NAA-SR-Memo-6918) PROPOSED TESTS OF A MECHANICAL SEAL FOR POPR COOLANT PUMP. R. W. Atz (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 14, 1961. Contract AT-11-1-GEN-8. Dep.(mn); $1.00(cy), 1(mn) OTS.

An apparatus was built to test shaft seals under conditions equivalent to those in the POPR organic coolant pump. A double face-type mechanical seal was selected for the first test; it has an impellor for circulating a flushing-cooling fluid. The seal test procedure is described. (D.L.C.)

9310 (NASA-CR-54013) SUNFLOWER I CONDENSER-SUBCOOLER. (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). June 1, 1964. Contract NAS 5-462. 156p. (ER-5088)

The mercury condensing development for Sunflower I is described. The objective of this program was to provide a full-scale condenser-subcooler component suitable for integration into the Sunflower I power conversion system. (auth)

9311 (NASA-CR-54174) SUNFLOWER POWER SYSTEM TEST REPORT. (Thompson Ramo Wooldridge Inc. TRW Equipment Labs., Cleveland). Oct. 1964. 99p. (N65-13095; ER-5396A)

The Sunflower PCS I-1 system which was composed of the preprototype hardware of each major component was assembled and tested to determine component compatibility and system performance. The component integration was consistent with the flight specification of operating the condenser in a condensing direction opposing the gravitational field. Testing was augmented by auxiliary facilities for startup and steady state operation as required. The program consisted of three separate tests which included individual system startups and a total accumulated operational time of 47 hours. Testing confirmed the integration of the preprototype components and their ability to operate in a system fashion. However, operation was characterized by sensitivity of the condenser to the operating conditions. The condenser performance was aggravated by a condition of tube wetting and the influence of liquid leakage into the condenser inlet through the turbomachinery seals. (auth)

9312 (NP-14494) ANALYSIS OF ELECTRON-ION MIXING IN ION ENGINES. Quarterly Report No. 1, May 1, 1964–July 31, 1964. R. P. Wadhwa and D. F. Brauch (Litton Industries, San Carlos, Calif.). Aug. 20, 1964. Contract NAS3-5757. 47p.

The use of Fourier analysis and marching method in solving Poisson's equation is briefly discussed as applied toward the simulation of an ion engine on a high-speed digital computer. The mathematical formulation for a cylindrical electron emitter (decel system) used for space-charge neutralization of the ion beam includes emission of electrons with random velocities according to Maxwellian velocity distribution, electron interception, and a capacitance matrix for simulating the voltage distribution of the decel system. The mathematical formulation for the simulation of both velocity and potential distribution along the accel plane is given. Expressions for evaluating the normalized equivalent temperature for electrons and ions are derived. (auth)

9313 (RT/ING(64)-9) HOT LABORATORY OPERATING EXPERIENCE AT C. N. E. N. C. Cesarano, E. Ghezzi, and M. Lauro (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Sept. 1964. 19p. Dep.(mn).

The Casaccia Hot Laboratory has been in operation since the end of 1961. The Laboratory includes three 1000°C (1 Mev) concrete cells and a lead cell which houses the metallograph. The operating experience has indicated that layout of the building and the distribution of space was in general satisfactory although some areas were showed to be underestimated. The main operating criterion is that in cell equipment must be small and easy to remove. Commercially available pieces of equipment for a specific job are preferable instead of universal machines. (auth)

9314 (WAPD-T-1689) EQUIPMENT FOR VIEWING AND PHOTOGRAPHING WITH THE REMOTE CONTROL STEREO ZOOM MICROSCOPE. J. H. Bowling and K. L. Rupp (Westinghouse Electric Corp. Bettis Atomic Power Lab., West Mifflin, Penna.). Oct. 1964. Contract AT-11-1-GEN-14. 10p. (CONF-654-28) Dep.(mn); $1.00(cy), 1(mn) OTS.

From American Nuclear Society Meeting, San Francisco, Nov.-Dec. 1964.

The Remote Control Stereo-Zoom Microscope is designed specifically for remote visual examination and 35 mm photography of radioactive materials. To move the samples into a position where they can be handled with the master slave manipulators, an elevating table was constructed. On top of the elevating table is a focusing table for focusing and locating the samples. To provide adequate illumination, a lighting system has been designed which incorporates four individually controlled 200-watt Quartzline lamps plus a vertical illuminator coupled with a 150-watt air cooled projection type lamp. These lights generate considerable heat, and to protect the microscope lens mounting system, the lights are mounted on a water cooled heat exchanger. Also described is the control box which incorporates the controls for the elevating table, focusing table, four Quartzline lamps, and the vertical illuminator. (D.L.C.)

9315 ION PROPULSION SYSTEM FOR STATIONARY-SATELLITE CONTROL. Jerome H. Molitor (Hughes Research Labs., Malibu, Calif.). J. Spacecraft Rockets, 1: 170-5(Mar.-Apr. 1964).

The application of ion propulsion to the 3-axes attitude control and station keeping of stationary satellites is discussed. The mission constraints that affect the engine system design, such as velocity increments associated with vernier orbit corrections, magnitude of disturbance torques, and required thrusting directions, are presented. An evaluation is made of the tradeoffs between such critical parameters as attitude and station-keeping accuracy, average power utilization, duty cycle, thrust level, and satellite mass and moments of inertia. A preliminary design is given for the ion engine attitude-control and station-keeping system. A prototype system was developed and laboratory tested. Such system parameters as power level, thrust level, specific impulse, and weight are specified. (auth)

9316 TESTS WITH SOLID BRUSHES ON THE CANBERRA HOMOPOLAR GENERATOR. R. A. Marshall (Australian National Univ., Canberra). Nature, 204: 1079 (Dec. 12, 1964).

An investigation to establish the feasibility of solid brush use in the Canberra homopolar generator is described. The tests demonstrated that large energy stores of this type are safe and practical. (J.R.D.)

9317 A RADIUM SAFE FROM POLAND. Radiography, 29: 359-60(Nov. 1963).

The design is described of a relatively small safe for the storage of 1 g of Ra in the form of standard seeds or needles. The safe, which may be built into the wall, insures full safety to personnel working near it in the Ra treatment room for periods of 30 hr/week. The safe is designed to insure rapid and maximally safe removal of the required seed or needle; rapid and completely safe control of the amount of Ra in stock; rapid safe replacement of any unused Ra; easy adaptation of the safe to the type and number of Ra units (seeds or needles) kept in stock; easy mounting in a wall, which helps to save useful space in the radiology room; and easy mounting in a free-standing position if required, after simple adaptation. (BBB)

9318 HEATING AND VENTILATION PLANT IN THE HOT AND ISOTOPE LABORATORIES AT THE FEDERAL INSTITUTE FOR REACTOR RESEARCH AT WÜRENLINGEN. F. Meyer. Sulzer Tech. Rev. (Switz.), 46: 57-65 (1964).

Hot laboratories designed for working with radioactive materials in enclosed spaces at below atmospheric pressure, using shielding and remote-controlled manipulators, are described. Ventilation installations have to meet particularly exacting requirements. Problems associated with ventilation and heating of the hot and isotope laboratories at Würenlingen are discussed. (auth)

9319 ELECTRICAL PROPULSION FOR SPACE MISSIONS: PLANNING CONSIDERATIONS. Benjamin Pinkel (Rand Corp., Santa Monica, Calif.). New York American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-715, 46p. $1.00. (CONF-640901-9)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

Information is presented pertinent to research and development planning relative to electric propulsion systems. Vehicle weights and costs for advanced space missions utilizing electrical propulsion systems and the competitive nuclear rocket and chemical rocket systems (the Manned Mars expedition, lunar logistic transport, and deep space probe missions), the estimated cost and time to develop the electric propulsion system, and the promise of new technologies are summarized. The development cost and time for an electric propulsion system in the megawatt power class based on current Rankine cycle technology (maximum cycle temperature 2000°F) are estimated at over three billion dollars and 12 years respectively. The mission studies revealed no economic or performance advantage sufficiently compelling to warrant the early initiation of a full scale development based on the current Rankine cycle technology. Present emphasis should be placed on exploratory engineering studies relating to Rankine, Brayton, and thermionic systems and research on new technologies. (auth)

Heat Transfer and Fluid Flow

Refer also to abstracts 9581, 10446, 10502, and 10518.

9320 (AD-603652) TWO-PHASE GAS-LIQUID FLOW OSCILLATIONS: PRELIMINARY SURVEY. S. William Gouse, Jr. (Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering). July 1964. Contract Nonr-1841(73). 56p. (DSR-8734-5). $3.00(OTS).

A review of a representative number of references for various types of two-phase gas-flow oscillations was conducted. The principal conclusion is that at this time there is no reliable way to predict the onset of, magnitude of, frequency of, and disappearance of flow oscillations in two-phase flow systems. A consensus of the existing experimental results indicates that the tendency for a system to oscillate can be reduced by reducing the inlet subcooling, increasing the system pressure level, eliminating heated section exit restrictions, decreasing fluid level in a riser, if present, and increasing the flow restriction at the heated section inlet. In addition, it is believed that useful stability maps can be prepared that indicate regions of operation in which there will be no flow oscillations. For a given fluid system, the parameters necessary to determine this map are geometry, inlet subcooling, flow rate and heat flux. (auth)

9321 (AD-606826) INVESTIGATION OF LIQUID METAL BOILING HEAT TRANSFER. Fifth Quarterly Progress Report. (Michigan. Univ., Ann Arbor. Coll. of Engineering). Sept. 1964. Contract AF33(657)-11548. 45p. $3.00 (OTS).

No additional burnout data have been obtained during this period. The equipment modification has been completed and rubidium will be charged during the next period. A numerical analysis of the edge effects in the 1-in. diameter film boiling apparatus has been completed. The uncertainty in condensing coefficients for sodium beneath the plate makes it difficult to correct for the large amount of heat which flows up the wall when the system operates in the film regime. A design for a modified boiler is presented. The forced convection apparatus was reassembled after the zirconium chips in the hot trap were replaced. Filters were added at several points in the system to collect suspended solids or oxide if either existed in the system. Despite all efforts, plugs still developed and flow was obtained for only brief periods during this time. The extremely small pumping restriction seems to accentuate the problem and consideration is being given to purchasing a new pump which might permit circulation for a period sufficiently long to collect all solids in the loop filters. The agravic apparatus was operated with mercury at a/g of one. Data were obtained in the nucleate, transition, and film regimes. (auth)

9322 (AE-165) MEASUREMENTS OF THE EFFECTS OF SPACERS ON THE BURNOUT CONDITIONS FOR FLOW OF BOILING WATER IN A VERTICAL ANNULUS AND A VERTICAL 7-ROD CLUSTER. Kurt Becker and Gunnar Hernborg (Aktiebolaget Atomenergi, Stockholm). Nov. 1964. 24p. Dep.(mn).

The following ranges of variables were studied and 162 burnout measurements were obtained. Pressure: $p = 31$ kg/cm^2. Inlet sub-cooling: $35 < \Delta t_{sub} < 174$°C. Surface heat flux: $89 < q/A < 305$ w/cm^2. Mass velocity: $94 < m/F < 900$ kg/m^{2}sec. Burnout steam quality: $0.10 < x_{BO} < 0.56$. The experimental results showed that the type of spacers employed during the present investigation had negligible effects on the burnout conditions and that the measured burnout heat fluxes could be predicted within ±5 per cent by means of the correlation by Becker et al. for flow in smooth channels. (auth)

9323 (AERE-R-3961) HEAT TRANSFER TO MIXTURES OF HIGH-PRESSURE STEAM AND WATER IN AN ANNULUS. PART IV. THE EFFECT OF TEST SECTION GEOMETRY. A. W. Bennett, J. G. Collier, and H. A. Kearsey (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1964. 61p. Dep.; $1.80(BIS); 9s. (HMSO).

Data are presented for burnout in steam/water flow in internally heated annuli at pressures from 75 to 1250 psia. These data were aimed at elucidating a number of geometrical factors in burnout, namely, the affect of heated length, the effect of heater diameter and annular gap, the effect of supporting the heater, the effect of the disposition of the heated length with respect to the inlet, and the effect of gross disturbances on the heated surface. Supporting the heater gives rise to a considerable increase in burnout heat flux above the unsupported case. This increase is not necessarily due to the elimination of bowing. As the heater length was increased, the burnout flux fell but the total power supplied to the rod at burnout increased. The effect of disposition of the heated length with respect to the channel inlet varied with quality. Within a narrow range, variations of heater diameter and annular gap did not appear to affect the power which can be fed to the rod before burnout for a given inlet quality. A disruption of the film flow along the heater caused by a recess machined in the surface led to a sharp fall in the burnout heat flux. (auth)

9324 (AERE-R-4613) A METHOD OF REPRESENTING BURNOUT DATA IN TWO-PHASE HEAT TRANSFER FOR UNIFORMLY HEATED ROUND TUBES. G. F. Hewitt (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1964. 28p. Dep.; $0/80 (BIS), 4s.(HMSO).

A useful way of representing burnout data is by plotting the fraction of the liquid that is evaporated before burnout takes place against the channel length over which the enthalpy of the fluid exceeds that of saturated water, (i.e. the 'boiling length'). Using burnout data from one reference, this method of plotting is developed into a simple graphical correlation covering the effects of diameter, mass velocity, and pressure for water. The correlation is then compared with other data, including recent data for Freon. (auth)

9325 (CEA-R-2499) CONVECTION FORCEE DE L'HYDROGENE LIQUIDE. 2 EME PARTIE. CAS DE GRANDS ECARTS DE TEMPERATURES ENTRE FLUIDE ET PAROI (CANAL CYLINDRIQUE). (Forced Convection of Liquid Hydrogen. Part II. Case of Large Temperature Differences Between the Fluid and the Wall (Cylindrical Channel). Paul Perroud and Jean Rebiere (France. Commissariat â l'Energie Atomique. Centre d'Etudes Nucleaires, Grenoble). Oct. 1964. 61p. Dep.(mn).

Measurements have been performed in a smooth Inconel tube of 2 mm ID and 2.5 mm OD, electrically heated on 300 mm by Joule effect. The liquid enters the test section subcooled at the constant temperature of 25°K average; then it is heated till complete vaporization occurs. The conditions are: inlet pressure (subcritical) 8 atm (a number of experiences have been made under supercritical pressure of 16 atm), mass velocity 11 to 115 g/cm^2-sec, heat flux density 9 to 385 w/cm^2, wall temperature reaching 800°K. The liquid hydrogen used was composed of about 60 per cent of para-hydrogen (the transformation para-ortho does not happen in the process). A flow model, connected with the wall temperatures observed, is established. In the region of two-phase flow, the wall temperature highly decreases and passes through a minimum just when the steam quality reaches unity. A correlation for the heat transfer coefficients is given, in the two-phase flow region (steam quality from 0 to 1) and in the region of homogeneous gaseous phase (Reynolds numbers varying from 15,000 to 420,000). Comparison with former correlations is also given. In the mixed-phase region, head losses due to friction are negligible with the respect to the pressure drop due to the variation of momentum. This latter can be calculated with good approximation using one-dimensional model. The head losses in gaseous phase follows the classical laws. Physical properties of liquid hydrogen extracted from the most recent literature, are given in supplement. (auth)

9326 (GEAP-4727) TRANSITION BOILING HEAT TRANSFER PROGRAM. Quarterly Progress Report No. 7, July–September 1964. E. P. Quinn (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Oct. 1, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 27p. (EURAEC-1244). Dep. (mn); $2.00(cy), 1(mn) OTS.

Transition boiling heat transfer results are presented for a single, $\frac{1}{2}$-inch-diameter, heated rod in a $\frac{3}{8}$-inch hydraulic diameter annular duct. Conditions at 1000 psia were at 0.5, 1.0, and 1.5 million lb/hr-ft^2 mass velocities, covering a 20 to 55 percent steam quality range. Transition boiling in the absence of large flow oscillations does not appear to present a serious design barrier to operation in film boiling. Three heated surfaces were investigated: smooth, 0.002 inch, and 0.004 inch high special finned surfaces. The effect of the fins on reducing transition boiling wall temperature fluctuations and increasing film boiling coefficients is illustrated. Test section pressure drop measurements recorded during the tests were very steady, indicating that over-all loop disturbances were essentially absent and that this transition boiling data represents the inherent heat transfer process. (auth)

9327 (GEAP-4749) HEAT TRANSFER TO SUPERHEATED STEAM. II. IMPROVED PERFORMANCE WITH TURBULENCE PROMOTERS. W. A. Sutherland and C. W. Miller (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Nov. 1964. Contract AT(04-3)-189. 32p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Heat transfer and flow friction measurements have been made with superheated steam in a circular tube to investigate the improved performance to be gained with boundary layer turbulence promoters. Data are presented for hydrodynamically and thermally fully established conditions for one type of discrete roughness configuration. The influence on the heat transfer coefficient of fluid property variation and of Prandtl number are found to be similar for both smooth and rough walls, and the data compare well with predictions for boundary layer turbulence promoters based on measurements with air in an annular geometry. (auth)

9328 (IRD-63-82) FLOW PROCESSES IN MPD GENERATORS. I. R. McNab and N. A. Cooper (International Research & Development Co. Ltd., Newcastle-upon-Tyne, England). Oct. 1963. Contract N62558-3127. 59p. (AD-422399) $6.60(OTS).

The flow processes in MPD generators are concerned particularly with the conditions in the first test section of the IRD generator. Thus the flow equations were solved for a constant-area channel with supersonic flow and include the effects of power extraction, heat loss, wall friction and non-constant electrical conductivity. The electrical conductivity depends on the electron density, which may be at the thermal equilibrium value, or above it, if electron heating occurs. Solutions for both cases are investigated and the assumptions inherent in the solution of the flow equations are considered. (auth)

9329 (LA-3177-MS) THE INTEGRATED PRESSURE DROP IN TWO-PHASE, NONADIABATIC FLOW OF HYDROGEN. John R. Bartlit (Los Alamos Scientific Lab., N. Mex.). July 4, 1964. Contract W-7405-eng-36. 12p. Dep.; $1.00(OTS)

A method is presented which permits the use of the Lockhart-Martinelli equations to calculate frictional pressure drops for the case of two-phase, flowing hydrogen with heat addition. The method eliminates stepwise calculations. Values of the special parameters needed to do this are given. (auth)

9330 (NP-14605) FEASIBILITY INVESTIGATION OF CAVITATION NUMBER MEASUREMENTS IN MERCURY AND WATER WITH GAS INJECTION. Technical Report No. 2. F. G. Hammitt, D. Ericson, R. Ivany, R. Garcia, and M. J. Robinson (Michigan. Univ., Ann Arbor. Coll. of Engineering). July 1964. Contract N41S6BA-002006. 83p.

A preliminary investigation was conducted on the feasibility of injecting gas in a cavitating venturi test loop with mercury and evaluating the effect of the gas content on the incipient cavitation number. Initial data for both mercury and water have been attained. The ultimate goal is to measure the effect of entrained hydrogen in mercury at 500°F on the cavitation number. Preliminary results for cavitation number measurements versus entrained argon in mercury are reported. Also included are results from cavitation number measurements in water with variable air content in the same venturi used for the mercury tests, for comparison to the mercury data. Five methods have been developed for measuring the gas content in a mercury sample extracted from the loop via sampling capsules. A successful method for injection of gases into the loop, resulting in good dispersion and atomization, is described. An acoustic method and a radiographic method for detecting cavitation in an opaque venturi for ultimate use with a stainless steel venturi for the high temperature tests are also described. Successful long-term operation of the loop at 500° F was demonstrated. It was determined that hydrogen could be safely used in the present facility with minimum modifications. (auth)

9331 (PWA-2320(Vol. 1) ANALYTICAL STUDY OF LIQUID METAL CONDENSERS. VOLUME 1. DESIGN STUDY. H. L. Hess, H. R. Kunz, and S. S. Wyde (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). July 15, 1964. Contract NAS3-2335. 226p. (NASA-CR-54224)

A study was made to identify the optimum condenser for Rankine-cycle space powerplant applications. The present state of liquid-metal technology was evaluated, and thermal and mechanical design procedures were formulated for liquid-metal condensers. Different condenser-heat rejection loop arrangements and condenser configurations were studied. The optimum condenser was found to be constant-diameter shell-and-tube configuration operating in parallel with similar units. (D.L.C.)

9332 (PWAC-430) FORCED-CONVECTION BOILING-POTASSIUM EXPERIMENTS. G. W. Bersin, J. Horan, and D. Costales (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Dec. 23, 1964. Contract AT(30-1)-2789. 183p. Dep.; $5.00(OTS).

Over-all boiling heat transfer coefficients up to 3000 Btu/hr-ft^2-°F were determined for a full length helical-insert type potassium boiler tube at 100-percent exit quality. Boiling pressure drop data were obtained for both twisted-ribbon and helical-insert type potassium boiler tubes over a range of exit qualities up to 100 percent. Liquid-liquid heat transfer data were obtained for a helical-insert type boiler tube at Peclet Numbers between 3 and 30 with corresponding Nusselt Numbers between 0.01 and 0.2. System stability observations were made and are discussed with emphasis on boiler and condenser contributions. (auth)

9333 (RT/ING(64)-8) PERDITA DI CARICO DOVUTA A VARIAZIONI DI QUOTA NEL MOTO VERTICALE ADIABATICO DI MISCELE BIFASICHE. (Loss of Pressure Due to Elevation Changes in the Adiabatic Vertical Motion of Biphase Mixtures). V. Magri (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). May 1964. 15p. Dep.(mn).

The equivalence between the energy theorem and the momentum theorem in the calculation of the total pressure drop is considered, and the significance of the losses of pressure due to friction and to elevation in the vertical adiabatic motion of biphase mixtures is put in evidence. (auth)

9334 (WAPD-Trans-12) A MODEL OF BOILING CRISIS FOR THE FORCED FLOW OF A LIQUID IN CHANNELS. A. A. Ivashkevich. Translated for Westinghouse Electric Corp., Pittsburgh, from Teploenerg., 11: No. 6, 66-9(1964). 9p. Dep.(mn); $1.00(cy), 1(mn) OTS; $1.10 (fs), $0.80(mf) JCL.

On the basis of a proposed model of boiling crisis, a qualitative explanation is given of the effect of the liquid flow parameters and channel dimensions on the magnitude of critical heat fluxes during the boiling of liquids in channels. (auth)

9335 VELOCITY PROFILES OF THORIA SUSPENSIONS IN TURBULENT PIPE FLOW. D. M. Eissenberg and D. C. Bogue (Oak Ridge National Lab., Tenn.). A.I.Ch.E. (Am. Inst. Chem. Engrs.) J., 10: 723-7(Sept. 1964).

Velocity profiles and friction factors of non-Newtonian fluids in turbulent pipe flow can be displayed with the semiempirical forms developed for Newtonian fluids in which the apparent viscosity evaluated at the wall shear stress is used. Friction factors and velocity profiles were obtained for a dilute and a concentrated aqueous thoria suspension and compared with Newtonian correlations and with previous data obtained from widely different non-Newtonian fluids including a viscoelastic fluid. A relationship is shown between the decrease of the friction factor and the change in the velocity distribution towards a more laminar profile. A generalized method of deriving the friction factor-Reynolds number plot from the velocity profile based on the von Kármán relationship for Newtonian fluids was derived and compared with the data. (auth)

9336 INVESTIGATION OF CRITICAL THERMAL FLUX IN PIPES WITH MONOISOPROPYLBIPHENYL UNDERHEATED TO SATURATION POINT. F. F. Bogdanov. At. Energ. (USSR), 17: 408-10(Nov. 1964). (In Russian)

Critical heat flow at the internal surface of a vertical pipe of diameter 15 mm and length 200 mm was studied for monoisopropylbiphenyl at various velocities and at various values of underheating to the saturation temperature. Variations of the critical thermal flow with coolant underheating are presented for coolant velocities of 2 to 4.5 m/sec at overpressures of 200 to 300 kg/m^2. The dependence of critical thermal flow on coolant velocity is given for constant underheating to 120 and 175°C saturation temperature. The data are fitted with an empirical relation and compared with previous data. The data permitted the effect of underheating on the critical thermal load to be established and the dependence of the critical load value on the coolant velocity to be determined for a wide range of conditions. (M.J.T.)

9337 A STUDY ON THE HYDRODYNAMIC INSTABILITY IN BOILING CHANNELS. 1ST REPORT, THE INSTABILITY IN A SINGLE BOILING CHANNEL. Shinji Hayama (Tokyo Univ.). Bull. JSME (Japan Soc. Mech. Engrs.), 23: 549-56(Aug. 1963). (In Japanese)

An investigation was made of the hydrodynamic instability, which was observed in two-phase flow systems, such as boiling water reactors and once-through boilers. A system with a single boiling channel was treated. The equation of oscillation for the circulation flow rate was derived from the laws of conservation of mass, energy, and momentum. The damping coefficient in this equation was given as the inclination of the characteristic curve that represents the relation between pressure losses and circulation flow rate. As the result, it is found that, when the equilibrium of the hydrodynamic system lies in the range of negative inclination of the characteristic curve, the system is unstable and a hydrodynamic oscillation is generated. In the case of forced circulation, the system was expected to be more stable than in the case of natural circulation because of the positive damping caused by the pump included in the circuit. (auth)

9338 TOTAL HEAT TRANSFER IN ELECTROLYTE IN THE PRESENCE OF MAGNETIC FIELD. E. Ya. Blums (Inst. of Power Engineering, Academy of Sciences, Latvian SSR). Latvijas PSR Zinatnu Akad., Vestis, Fiz. Tek. Zinatnu Ser., No. 4, 23-30(1964). (In Russian)

An experimental investigation into electrolytic solutions used as a heat-transfer medium in square channels in the presence of a transverse magnetic field (up to 12,000 gs) is described. Experimental equipment and a section of the channel are shown. The results obtained showed that the values of the flow shift, in comparison with the case for round tubes, to smaller Reynolds' numbers when the transition from laminar flow to turbulent flow takes place. The heat transfer is affected by the transverse magnetic field and the decrease in the heat transfer is a function of Hartmann's number. At Hartmann's number M = 1.1 the decrease corresponds to 1.3%. (auth)

9339 CONDUCTING LIQUID FLOW AROUND BODIES IN A MAGNETIC FIELD. A. B. Tsinober, A. G. Shtern, and E. V. Shcherbinin (Inst. of Physics, Academy of Sciences, Latvian SSR). Latvijas PSR Zinatnu Akad., Vestis, Fiz. Tek. Zinatnu Ser., No. 4, 31-40(1964). (In Russian)

Studies were continued on the effect of magnetic fields on the resistive drag force during the flow of conducting liquids around bodies made of insulating materials. In the case examined, mercury flowed around conducting bodies. It was found that in the presence of a good contact between the body and the mercury the drag increased with increased conductivity of the objects. The influence of the magnetic field on pressure distribution across a circular cylinder was also studied. The added magnetic field caused an increase in pressure at the front section of the cylinder, while an inverse effect took place at the back part of the cylinder. The increase in drag force due to the change in pressure represents some 40 to 50% of the total drag force increase. The qualitative results of the experiments agreed with other studies. (OTS)

9340 FORCED CONVECTION HEAT TRANSFER AND PRESSURE DROP IN ARTIFICIALLY ROUGHENED FLOW PASSAGES. V. Kaul (Eidgenossische Institut fur Reaktorforschung, Wurenlingen, Switzerland) and M. von Kiss. Neue Tech., 6: 297-309(Dec. 1964).

A method is given, which allows comparison of friction factors and heat transfer coefficients measured in flow geometries having different proportions of rough to smooth surfaces. Using this method, all available measurements were compared. As a result of this comparison, equations for evaluating friction factors and heat transfer coefficients in reactors with artificially roughened fuel elements are suggested. (auth)

9341 HEAT TRANSFER AND PRESSURE DROP MEASUREMENTS ON LONGITUDINAL FINS. M. von Kiss (Eidgenossische Technische Hochschule, Wurenlingen, Switzerland). Neue Tech., 6: 310-17(Dec. 1964). (In German)

Pressure drop and heat transfer coefficients were measured on longitudinal fins. According to these measurements, in which the gap between the top of the fins and the channel-wall was variable, a correction factor was determined to the usual calculating method. A comparison was also made between the longitudinal and polyzonal fins. (auth)

9342 THE MECHANISM OF BURNOUT IN INITIALLY SUB-COOLED FORCED CONVECTIVE SYSTEMS. Thomas Michael Grace. Thesis, Minneapolis, Univ. of Minnesota, 1964. 149p.

An analysis is made of burnout in convective two-phase systems with particular emphasis directed toward understanding the physical mechanisms. Various aspects of two-phase flow were examined including flow regimes, film flow and entrainment, and two-phase heat transfer as well as direct burnout experiments. This analysis is concerned with burnout due to transition from convection-dominated heat transfer to a liquid-deficient heat transfer region. The analysis indicates that the pre-burnout conditions are dominated by the flow of liquid in a thin film on the heated surface, and that burnout occurs when this film flow dries up. The rate of supply of liquid to the heated surface by diffusion of droplets from the core may be considered negligibly small when a heat flux is present. This means there is a great difference between systems that are initially subcooled, and those in which a dispersed two-phase feed is used. The postulate that burnout conditions for dispersed feed systems are determined in the entrance region before the start of the heated section allows a qualitative prediction of several effects observed in these systems. The film flow mechanism was used to derive equations for burnout in initially subcooled systems based on a model considering removal of liquid from the film by evaporation and entrainment. This model gives a reasonably good correlation of burnout data. The results indicate that a model not based on droplet diffusion can correlate burnout data quite well, and that, in fact, droplet diffusion in the heated section has little effect on burnout. (Dissertation Abstr., 25: No. 3, Sept. 1964)

9343 HEAT TRANSFER CHARACTERISTICS OF BOILING NITROGEN AND NEON IN NARROW ANNULI. A. Lapin (Air Products and Chemicals, Inc., Allentown, Penna.), H. C. Totten, and L. A. Wenzel. New York, American Inst. of Chemical Engineers, Preprint 38d, 43p, $0.50. (CONF-641201-10)

From American Institute of Chemical Engineers Annual Meeting, Boston.

An investigation was made of neon and nitrogen boiling in narrow annuli. The study covered the case of a 7.5-in. long vertical heater with a nominal 3-in. outside diameter. Gap sizes ranged from 0.006 to 0.080 in., and L/De ratios varied between 9 and 310. The experimental design concept allowed for visual observation simultaneously with data collection, which made it possible to relate data directly to observed behavior. A generalized equation for annular gap boiling was derived on the assumption of convective heat transfer. The concept of equivalent diameter was used to modify the characteristic dimension in the Nusselt and Reynolds numbers. An equation was developed, which correlated all annular gap boiling data obtained with nitrogen and neon with an average percent deviation of ±23%. The validity of the correlation over the wide range of parameters involved in the experimental work substantiated the assumptions made and concepts involved in the derivation of the equation. It was concluded, however, that while this equation would be satisfactory for cryogenic fluids in general, certain size limitations should be considered, namely, vertical height less than 15 in. and annular gap sizes in the order of 0.006 to 0.080 in. This range of gap sizes almost completely covers the range for narrow annuli. (auth)

9344 CONVECTIVE HEAT TRANSFER OF GASES FLOWING ACROSS BUNDLES OF MULTI-START HELICAL TUBES WITH UNIFORM INCLINATION AND UNIFORM LONGITUDINAL PITCHES. P. V. Gilli (Waagner-Biro AG, Vienna). 21p. (CONF-446-68)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

Investigation was conducted on heat transfer in tubes arranged so that the number of starts increases proportionally to coil diameter; thus uniform inclinations and uniform tube lengths are obtained all over the bundle. It is neglected, for this consideration, that the effects of tube curvature, flow rates, and heat loads per tube are equal in all helical tubes, which is an important feature for instance in the superheater portion. However, the tube pattern depends in this arrangement on the perimetric position. It changes continuously between in-line, irregularly staggered and regularly staggered arrangements. An analytical approach is presented for evaluating the gas-side heat transfer coefficient of such a system from straight tube data by accounting for tube inclination and by assessing the effective minimum free gas flow area and the effective arrangement factor. (J.R.D.)

9345 STUDIES OF BOILING HEAT TRANSFER WITH ELECTRICAL FIELDS. PARTS I & II. Michael Markels, Jr. and R. L. Durfee (Atlantic Research Nuclear Corp., Alexandria, Va.). New York, American Inst. of Chemical Engineers, 1964, Preprint 38b, 22p., $0.50. (CONF-641201-5)

From American Institute of Chemical Engineers Annual Meeting, Boston.

Voltage effects were studied in a flow system to determine possible effects of flow rate and exit quality on the applied voltage process of increasing boiling heat transfer coefficients at atmospheric pressure. Other parameters studied with the flow system include water resistivity and test section geometry. The results showed that the heat transfer rate to flowing water can be increased by a-c voltage applied across the region of vapor formation at any practical mass flow rate. Based on the increase of heat flux with voltage in the externally heated case at 1000 and 2000 volts, the condenser effect did influence the heat transfer, and, under some conditions, to a greater extent than dielectrophoresis. The voltage was generally made more effective by increasing the volume resistivity of the water. (P.C.H.)

9346 A TRANSIENT MULTICHANNEL TWO-PHASE HYDRAULIC CODE. L. R. Steele (Industrial Reactor Labs., Plainsboro, N. J.) and R. F. Berland. New York, American Inst. of Chemical Engineers, 1964, Preprint 47a, 30p, $0.50. (CONF-641201-3)

From American Institute of Chemical Engineers Annual Meeting, Boston.

The behavior of multichannel hydraulics under transient conditions is described. Incorporation of the effects of crossflow into a general model requires the use of a relatively simple form of the equations for conservation of mass, momentum, and energy. The approach used is based on integral transport equations. Development of the analytical model is described. The model was programmed for use on an IBM-7094 computer so that a rapid analysis of the transient behavior of a particular system may be determined. Comparison of the code was made for experimental data for parallel channel oscillations and that of a steady-state multichannel flow distribution. (P.C.H.)

Materials Testing

Refer also to abstracts 9429, 9657, 9668, and 10420.

9347 (HW-SA-3400) NONDESTRUCTIVE TESTER PROBLEMS IN PRODUCTION APPLICATIONS: SENSITIVITY, MEASUREMENT ERROR AND ECONOMIC CONSIDERATIONS. C. J. Denton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 5, 1964. Contract AT(45-1)-1350. 6p. (CONF-662-2) Dep.(mn); $1.00(cy), 1(mn) OTS.

From 24th National Convention of Society for Nondestructive Testing, Philadelphia, Oct. 1964.

The large tonnages of reactor elements fabricated for use in Hanford reactors must be nondestructively tested to rigid quality specifications to prevent costly failures in use. Testing this large volume of elements reliably and at a minimum of cost with electronically and mechanically complex nondestructive testers is a major fuel production problem. Simple control charts are indispensable in maintaining control of the various units in the tester complex. A unique, statistically designed measurement error program has been devised to monitor and identify measurement error problems with the various testers in the tester complex. (auth)

9348 (FTD-MT-63-261) ROENTGENOGRAPHY. G. F. Kosolapov. Translation of p.1-332 from "Rentgenografiya," (a publication of the State Printing House for Higher Education, Moscow, 1962). 307p. OTS.

Industrial applications of radiography are reviewed. Topics discussed include the characteristics of x-ray spectra; absorption of x rays; x-ray equipment used in industrial measurements; applications of x-ray methods in studies of crystal structure; applications of x-ray photographs in determinations of the contents of metals in alloys and the limits of solubility of metals in alloys at various temperatures; applications of x rays in studies of the atomic structure of pure metals; applications of x radiation in studies on the structure of plastically deformed and recrystallized metals; applications of x-ray methods in determinations of residual stresses of metals; the x-ray analysis of heat-treated steel; the x-ray analysis of supersaturated solid solutions; the x-ray analysis of the structure of liquid metals; x-ray flow detection; methods used in electron diffraction analysis; and applications of neutron beams alone, or in conjunction with x radiation, in studies of the structure of compounds. The scattering curves of x rays and neutrons from a polycrystalline sample of UBe_{13} are included. (C.H.)

9349 CHARACTERIZING MATERIALS ABOVE 1500°C. J. L. Pentecost and L. K. Eliason (Melpar Inc., Falls Church, Va.). 12p. (CONF-640701-84)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Methods of generating high temperatures required for measuring property data above 1500°C are discussed along with associated instrumentation. Discussions are included on furnaces and heat sources, measuring devices and techniques, mechanical property measurement, and thermal property measurement. (J.R.D.)

Protective Structures

9350 (AD-602854) A SUMMARY OF THE FINAL REPORT—FAMILY ADOPTION OF PUBLIC FALLOUT SHELTERS. A Study of Des Moines, Iowa. Gerald E. Klonglan, George M. Beal, and Joe M. Bohlen (Iowa Agricultural and Home Economics Experiment Station, Ames). 1964. Contract OCD-OS-62-150. 17p. $1.00(OTS).

A study was made of how people adopt the idea of using public fallout shelters. Five stages in the adoption process are defined: awareness, information, evaluation, trial, and finally adoption. The population in Des Moines was classified into the above stages. The relation of the following factors to the stage of adoption was studied: demographic, knowledge, attitude, and sources of information. (D.L.C.)

9351 (AD-603068) MINIMUM REQUIREMENTS FOR AUXILIARY POWER SYSTEMS FOR COMMUNITY SHELTERS. Summary Report. D. A. Trayser, L. J. Flanigan, and S. G. Talbert (Battelle Memorial Inst., Columbus, Ohio). July 15, 1964. Contract OCD-OS-62-190. 186p. $5.00(OTS).

The results of this study show that the minimum requirements for installation, operation, and maintenance of shelter auxiliary power systems can generally be met with commercially available equipment now in common industrial use. To facilitate the use of the information the presentation of results is divided into ten sections: Prime movers, Starting systems, Cooling, Fuel storage, Waste heat recovery, Power transmission systems, Mountings and drives, Noise and vibration, Stand-by maintenance, and Demonstration unit. (auth)

9352 (AD-603227) SMALL AUXILIARY POWER SYSTEMS FOR SHELTERS. Summary of Research Report. (Smith (A. O.) Corp., Milwaukee). May 1964. Contract OCD-OS-62-282. 145p. $5.00(OTS).

Conventional and unconventional methods of storage of engine-generator sets and a fuel supply are discussed; recommendations are made based on the present state of the art. Methods for removal of waste heat and noxious fumes and control of noise and vibration are discussed to facilitate installation of engine-generator sets in shelters. Several means of utilizing engine waste heat for other shelter activities are presented and discussed; also, means of utilizing more conventional heating devices are considered. Installation, maintenance, and repair procedures as well as operating instructions are discussed in detail. Finally, a thermodynamic analysis and preliminary design of two Rankine-cycle power generators utilizing a turbine and reciprocating engine respectively are included. Preliminary designs of the required auxiliary equipment are presented and discussed in some detail. (auth)

9353 (ESD-TDR-64-134) A PRELIMINARY GEOLOGIC ASSESSMENT OF SELECTED SITES IN THE UNITED STATES THAT MAY BE SUITABLE FOR DEEP UNDERGROUND COMMAND AND CONTROL CENTERS. G. A. Kiersch and W. D. Gunther (Mitre Corp., Bedford, Mass.). June 1964. Contract AF19(628)-2390. 153p. (AD-603158; SR-110). $5.00(OTS).

A general procedure is developed for the preliminary geological assessment of any deep underground site, and subsequently applied to sites available in the continental United States that would provide at least 5000 feet of suitable geologic cover using a horizontal tunnel access. The 5000 foot criterion is arbitrary; it should, however, be representative to the depth of cover required to withstand the threats postulated. Application of the preliminary site assessment criterion to these possible sites resulted in the selection of thirteen sites that appear adequate for location of a deep underground installation. These thirteen sites are then further evaluated in the light of geology, logistics, and other military considerations and rated accordingly. (auth)

9354 (GDC-64-026) ANALYSIS AND DESIGN OF CBR PROTECTION FOR THE AN/TSQ-47 SYSTEM. Final Report. D. R. Walin (General Dynamics/Convair, San Diego, Calif.). July 1964. Contract AF19(628)-3275. 137p. (ESD-TDR-64-230; AD-603100). $4.00(OTS)

This document covers the analysis and design of CBR protection for AN/TSQ-47 system shelters. Standard CBR protection components were selected based on Category A protection requirements and a shelter system analysis. The E46R7 filter unit, Q-38 protective entrance (short), and E31 anti-backdraft valve, each with minor modifications, are the recommended CBR protection components. In addition, a booster blower unit is required in the shelter recirculation system to reduce shelter pressure. Components are sized based on assumed leakage and pressure drop characteristics. The values assumed are considered to be within 10% of actual values. Tests are defined to verify the assumptions if verification is considered necessary. (auth)

9355 (HI-361-RR/2) THE DESIGN AND PERFORMANCE OF "OPTIMUM" BLAST SHELTER PROGRAMS. Final Report. William M. Brown (Hudson Inst., Inc., Croton-on-Hudson, N. Y.). June 11, 1964. Contract OCD-OS-63-122. 53p. (AD-602850). $3.00 OTS.

A mathematical model is developed from which the cost of a national blast shelter program for the 213 urbanized areas of the U. S. can be calculated, and from which the effectiveness of the program in providing blast protection for the urban citizens can be quickly found. This model, by utilizing the idea of equalizing the value of all urban areas as targets (from the enemy point of view), (a) denies the enemy any preferred targets, from the point of view of population mortalities, and (b) provides an important kind of equality of population vulnerability among the urban areas. The design has the advantage of minimizing the number of blast fatalities which an enemy can achieve, and thereby can contribute to the reduction of national vulnerability. To a large extent the basic design is independent of the size and nature of the assumed attack, although this is less true of the later refinements which involve the use of partial dispersal and crowding. The three essential elements required in the initial model are: (1) the mathematical relationship between blast overpressure and lethal area from any nuclear explosion; (2) the population density distribution within the urban areas of the U. S.; and (3) the estimated cost of shelters as a function of the design overpressure.

Each of the above three factors is estimated, and the results combined to obtain the cost of alternative national programs for the 96 million people (1960) of the largest 213 urbanized areas in the U. S. The results can generally be expressed in terms of a simple vulnerability criterion, β, which represents the maximum number of fatalities expected from a 1-MT explosion. For each of several values of β the cost of urban shelters for a national program is found from the model and the results presented both in tabular and graphical forms. For a program with a given β, for any attack consisting of an array of megaton weapons $\{W_j\}$ the number of blast fatalities among the sheltered is given by the equation fatalities $\leqq \beta\, \Sigma_j W_j$. Several examples are given of determining the effectiveness of the programs under some hypothetical attacks against population. By utilizing an option for partially dispersing the population of congested cities, two additional beneficial effects can be attained. First, the requirement for extremely hard shelters in the very congested areas is relieved. Secondly, since the cost of sheltering in outlying fringe or rural areas is substantially less than that within the cities, the option can be utilized to obtain either substantial reduction in the cose of a program utilizing a given vulnerability, or a substantial increase in the degree of protection which is obtainable. The results show that for a given budget the vulnerability to blast can be reduced between 50% and 80%. The discussion of costs have implicitly assumed 8 to 10 square feet of space per person. This allotment can be substantially modified and thus by "over-crowding" the shelters the costs of the program can again substantially be reduced (or, at fixed budget, the vulnerability can be reduced). By combining optimized design, dispersal, and (c) overcrowding, impressive blast protection can be obtained nationally at a cost between \$5 and \$10 billion. (D.L.C.)

9356 A COMPACT RADIUM SAFE EMPLOYING GAS STERILIZATION. Edward W. Webster (Massachusetts General Hospital, Boston), Milford D. Schulz, and E. Theodore Agard. Am. J. Roentgenol., Radium Therapy Nucl. Med., 93: 183-9(Jan. 1965).

A radium safe designed principally for storage of radium needles is described. The radium is stored in a small internal space (120 in.^{3}) almost entirely filled with stainless steel; this results in a small over-all size and weight. The sources can be withdrawn rapidly with a minimum handling and operator exposure. There is no bulky protective door. The sources are sterilized by ethylene oxide while inside the safe and, since they are already threaded, they are available for immediate use. The presence of each source is separately identified; provision is made for charting the location of sources when not in the safe. (P.C.H.)

9357 A NEW WHOLE-BODY COUNTER SHIELDING DESIGN. Karl-Friedrich Poulheim and Harri Hoesselbarth (Staatliche Zentrale fur Strahlenschutz, Berlin). Health Phys., 11: 52-4(Jan. 1965).

A whole-body counter, designed to serve for measurement of body burdens of radionuclides after accidents and for collecting experimental data, is described. A new shielding material, gypsum, was used. The thickness of the gypsum shielding, except at a few places, is at least 75 cm. The density of the gypsum bricks being 1.6 g/cm^3, the weight per unit area is at least 120 g/cm^2 (comparable to about 15 cm iron). The counting cell itself (140 cm in dia and 200 cm in length) consists of a water supply pipe made in 1925. The polished insulated steel pipe was embedded about with gypsum bricks that were analyzed for radioactive contamination before use. The interstitial space between the bricks and the pipe was filled with gypsum. The detector consists of a 100 × 70 mm NaI(Tl) crystal coupled with a photomultiplier S 12 FS 100. The gypsum shield reduced the background spectrum by a factor of 10 at an energy of 1 Mev and the reduction factor increases to 23 as energy decreases to 100 kev. (P.C.H.)

9358 FORM STONE FOR SHIELDING WALLS. Ruth Mumm. German Patent 1,174,040. July 16, 1964. Filed July 25, 1961.

A form stone is described which comprises two elongated walls connected by cross bars. The inner surface of the stone is coated with a radiation shielding material which is sprayed on in layers. (Gmelin Inst.)

Vacuum Engineering

Refer also to abstract 9453.

9359 (ORNL-P-818) RELEASE OF GASES FROM SURFACES BY ENERGETIC ELECTRONS. Robert E. Clausing (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 20p. (CONF-640903-2). Dep.(mn); \$1.00(cy), 1(mn) OTS.

From American Vacuum Society Symposium, Chicago.

Several experiments on gas release by electron bombardment of surfaces are described which suggest its possible use in vacuum techniques. The first experiments studied the yield (number of gas molecules desorbed by each electron) as a function of electron energy; it was found that yields of 10^{-3} to 10^{-1} could be obtained even in clean systems if 2- to 3-kev electrons were used, and that this cleaning effect is not a heating effect. Electron cleaning experiments on several vacuum systems were also conducted. A mass spectrometer was used to identify the gases being desorbed, and it is concluded that the nature of the sorbed gases is more important than the substrate in determining the amount and kind of gas evolved. An experiment on the bombardment of titanium getter films loaded with H_2 or CH_4 is also described. (D.L.C.)

9360 (ORNL-tr-302) HIGH-OUTPUT PUMP BY TITANIUM EVAPORATION AT LOW TEMPERATURE. F. Prevot and Z. Sledziewski (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses). Translated for Oak Ridge National Lab., Tenn., from report EUR-CEA-FC-260. Aug. 1964. 25p. Dep.(mn); \$2.60(fs), \$0.95(mf) JCL.

A titanium evaporation pump at liquid nitrogen temperature (active surface 12,000 cm^2) backed with an oil diffusion pump (diameter 60 cm) is described. The maximum sticking probability is about 0.9 for air and 0.3 for hydrogen giving pumping speeds of 127,000 l/sec and 150,000 l/sec, respectively. The pumping speed outside the pump is limited by the conductance at the entrance of the pump to values of 30,000 l/sec for air and 75,000 l/sec for hydrogen. The absorption capacity for a discontinuously deposited layer is limited to approximately 10^{15} molecules/cm^2. (auth)

GEOLOGY AND MINERALOGY

General

Refer also to abstracts 10659 and 10662.

9361 (HW-SA-3753) DESCRIPTION OF SOIL CHARACTERISTICS FOR PARTIALLY SATURATED FLOW. L. G. King (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 4, 1964. Contract AT(45-1)-1350. 19p. (CONF-641104-1). Dep.(mn); $1.00 (cy), 1(mn) OTS.

From Soil Science Society of America Annual Meeting, Kansas City, Mo.

Two empirical equations are presented for describing relative permeability as a function of capillary pressure. Of the two, the modified Gardner's equation appears to fit the experimental data better and is certainly easier to use because of its simple form. An equation is also presented for representing saturation as a function of capillary pressure. This equation is differentiable. Results are presented for using the equations to calculate relative permeability and diffusivity as functions of saturation. (auth)

9362 (MITS-52) ADAPTATION OF NEW RESEARCH TECHNIQUES TO MINERAL ENGINEERING PROBLEMS. Annual Progress Report for the Period Ending October 31, 1964. (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). Oct. 31, 1964. Contract AT(30-1)-956. 12p. (NYO-10332). Dep.(mn); $1.00(cy), 1(mn) OTS.

Research activities at MIT on mineral engineering problems are summarized. Information is included on: surfactant dimers and their adsorption, liberation on comminution, gas-phase conditioning for flotation of a phosphate ore, contact angles and adsorption in the quartz-water dodecane system modified by dodecyl ammonium chloride, reactions between galena and ethyl xanthate, particle size determination by combined centrifugation and gamma emission, radioactive tracer studies in wet ball milling, beryl flotation, and hysteresis of contact angles in the galena-aqueous potassium ethyl xanthate-nitrogen system. (N.W.R.)

9363 (TID-21432) THE SOILS OF RONGELAP ATOLL, MARSHALL ISLANDS (thesis). Reid M. Kenady (Washington. Univ., Seattle). 1962. Contract AT(45-1)-1385. 99p. Dep.(mn); $3.00(cy), 2(mn) OTS.

A study was made of the soils of Rongelap Atoll in the Northern Marshall Islands. Seven soil types were identified and descriptions made using (1) a representative profile description (2) results of the laboratory analysis performed on samples collected from these profiles, and (3) a general description of the soil type including its topography, associated vegetation, the factors influencing its development, and the distribution of the soil type on the atoll. The results show that there are several important features which characterize these soils. They are generally quite young, forming on calcareous sands deposited on reef flats by salt water. In many areas the process of land building is still taking place as evidenced by the presence of many buried horizons. Vegetation is the most important soil forming factor, resulting in the development of a surface horizon which contains organic matter derived from decaying plant material. The presence of organic matter in the soil influences a number of soil properties; it provides nitrogen and other nutrients needed for plant growth while physically improving the soil. The decomposition of plant materials releases humic acids which substantially reduce the pH of the normally basic parent material. Finally the organic colloids present in the soil make up a great portion of the exchange complex from which plants obtain nutrient ions. Organic matter and nitrogen relationships are discussed. A relationship for predicting organic matter content from nitrogen values is developed. Some statistical treatment of the chemical analysis data is presented, which substantiates the separation of the soil types which are described. Levels of phosphorous and other elements are discussed and graphical comparisons are made between several of the described soils. (auth)

Natural Radioactivity and Fallout

Refer also to abstracts 8737, 8792, 9759, and 10372.

9364 (AD-420825) WEATHER—AWS PARTICIPATION IN RADIOLOGICAL DEFENSE PROGRAMS. (Air Weather Service, Scott AFB, Ill.). Oct. 1, 1963. 43p. (AWSM-105-33) $4.60(OTS).

Standard procedures are presented that are to be followed by Air Weather Service (AWS) units participating in disaster control programs, including the observation and reporting of nuclear detonations and the assistance provided through fallout plots. (auth)

9365 (HASL-155) FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, SEPTEMBER 1, 1964–DECEMBER 1, 1964. Edward P. Hardy, Jr. and Joseph Rivera (New York Operations Office. Health and Safety Lab., AEC). Jan. 1, 1965. 314p. Dep.; $4.00(OTS).

Presented are current data from the HASL Fallout Program, the New Zealand Department of Scientific and Industrial Research, the National Radiation Laboratory in New Zealand, Argonne National Laboratory, and Service de Protection, C. C. R. EURATOM, Ispra, Italy. Radionuclide levels in fallout, milk, tap water, and upper air samples are given in tabular form. Also included are interpretive reports and notes dealing with estimated 1964 ^{90}Sr deposition in New York City, effect of precipitation on ^{90}Sr deposition, use of limited number of soil sites for estimating worldwide deposition, measurements of ^{22}Na in fallout, herbage, and milk, effect of wheat stripping on radionuclide levels in flour, and ^{238}Pu measurements in air at high altitude. A bibliography of recent literature pertinent to fallout studies is given. (auth)

9366 (HW-SA-3316) GAMMA-EMITTING RADIONUCLIDES IN ALASKAN TUNDRA VEGETATION, 1959, 1960, 1961. W. H. Rickard, J. J. Davis, W. C. Hanson, and D. G. Watson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Jan. 10, 1964]. Contract AT(45-1)-1350. 17p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Samples of vegetation collected during 1959, 1960, and 1961 in the Ogotoruk Creek Valley, near Cape Thompson, Alaska, were analyzed for γ emitting radionuclides by means of γ spectrometry. Total radioactivity diminished from 1959 to 1961. Cerium-144 was the most abundant radionuclide present in the vegetation during the three years. In 1961 ^{137}Cs contributed a greater amount of fallout radioactivity than other radionuclides and lichens and mosses contained more ^{137}Cs than vascular plants, in which ^{137}Cs was associated with aboveground parts exposed to aerial deposition. Lesser amounts of ^{106}Ru, ^{95}Zr, ^{137}Cs, ^{54}Mn, and ^{65}Zn were also present in vegetation during the three study years. The ecology of the region is discussed. (C.H.)

9367 (IAEA-R-1) FACTORS CONTROLLING THE DISTRIBUTION OF FISSION PRODUCTS IN THE BIOSPHERE. Summary Report on the Research Project. T. Schoenfeld, K. Liebscher, and F. Karl (Vienna. Universität. Institut für Anorganische Chemie and Vienna. Universität. Institut für Physikalische Chemie). Mar. 1962. 186p. Dep.(mn).

Progress is reported in studies on factors controlling the distribution of fission products in the biosphere with emphasis on the behavior of fission products in surface waters and the deposition of inhaled fission products in human lungs. Measurement techniques used for the determination of fission products in samples of dust, rain water, surface waters, and vegetation are described, with emphasis on applications of gamma scintillation spectrometry. Radiochemical separation techniques are described. Procedures used for the β-counting of separated fission products are also described. Results are reported from experiments on the influence of various complexing agents on the uptake of radioisotopes by ion exchange resins and laboratory experiments on the adsorption of ^{89}Sr and ^{137}Cs by clays and other soil components. Procedures used in obtaining and evaluating the γ spectra of a number of fission products in samples from the biosphere are discussed. Data are included on the content of ^{89}Sr, ^{90}Sr, ^{141}Ce, ^{144}Ce, ^{137}Cs, ^{131}I, ^{95}Zr, ^{95}Nb, ^{103}Ru, ^{106}Ru, ^{106}Rh, ^{137}Ba, ^{140}Ba, ^{140}La, and ^{144}Pr in samples of dust, precipitation, surface water, drinking waters, lungs, and pulmonary lymph nodes analyzed during 1959, 1960, 1961 and 1962. The influence of the origin of air masses in atmospheric transport phenomena on the composition of the fission product mixture was demonstrated by determination of the relative amounts of ^{103}Ru, ^{95}Zr, and ^{95}Nb in rain water samples. The results show that atmospheric mixing was far from complete in 1962. The observed fission product concentrations are compared with the maximum permissible concentration values for radioisotopes established by the International Commission on Radiological Protection. Values for lung burdens of various fission products were plotted as a function of the date of death with emphasis on ^{144}Ce, ^{95}Zr, and ^{95}Nb. The data show that a steady rise in lung burden took place between Sept. 1961 and Feb. 1962. The data also indicate that considerable translocation of ^{144}Ce from lungs to pulmonary lymph nodes takes place and results in an increase in concentration in lymph nodes. (50 references.) (C.H.)

9368 (NP-14459) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 2, Number 10. (Canada. Dept. of National Health and Welfare. Radiation Protection Div., Ottawa). Oct. 1964. 53p. Dep.(mn).

Preliminary analysis of air filters showed the presence of short-lived fission products attributable to the Chinese nuclear weapon test on Oct. 16, 1964. Radiation levels were within permissible limits. Data are presented on radioactivity due to fallout in samples of air, precipitation, and milk collected at various locations throughout Canada during Sept. 1964. Results are included from measurements of the content of ^{89}Sr, ^{90}Sr, ^{137}Cs, and ^{131}I in milk samples. Results are also presented from measurements of the ^{90}Sr content in samples of soil and human bone collected during 1963. Activities during the monitoring of the environment at reactor sites, the monitoring of photographic film badges, and the monitoring of radioisotope users are reported. (C.H.)

9369 (NP-14502) RADIOACTIVITY SURVEY DATA IN JAPAN. NUMBER 2. (Japan. National Inst. of Radiological Sciences, Chiba). Feb. 1964. 31p. Dep.(mn).

Data are presented on the content of ^{90}Sr and ^{137}Cs from fallout in samples of rain water, air, drinking water, ground water, vegetables, fruits, meat, eggs, powdered milk, and green and black tea collected at various locations throughout Japan from July to Nov., 1963. (C.H.)

9370 (NP-14556(p.11-80)) RADIOACTIVE CONTAMINATION OF THE ENVIRONMENT BY NUCLEAR TESTS. (United Nations. Scientific Committee on the Effects of Atomic Radiation).

A detailed review is presented of data collected between 1962 and June 1964 on contamination of the environment by fallout from nuclear explosions. It is pointed out that the major part of all fission products produced by nuclear explosions up to the end of 1962 was released into the stratosphere and that estimates of future deposition rates require a knowledge of the fission product inventory in the stratosphere as well as of the mechanisms by which it is brought down to the ground. Topics discussed in detail include the transport of artificial radionuclides in the earth's atmosphere and mechanisms involved in deposition on the earth; the inventory of artificial radionuclides in the atmosphere, precipitation, soil, rivers, lakes, and oceans, with emphasis on levels of ^{90}Sr, ^{137}Cs, ^{85}Kr, ^{89}Sr, and ^{14}C; mechanisms involved in the movement of radionuclides through the food chain, and the metabolism and body burden of radionuclides in man, with emphasis on ^{89}Sr, ^{90}Sr, ^{137}Cs, and ^{131}I; and radiation doses to the population from environmental and internal contamination by fallout fission products. (34 tables. 430 references.) (C.H.)

9371 (NP-14618) FALLOUT IN NEW ZEALAND. Quarterly Report, July–September 1964. (New Zealand. National Radiation Lab., Christchurch). 21p. (NRL-F14). Dep.(mn).

Total gamma activities of air filter samples and total beta activities of rain at Auckland and Christchurch are given. The average deposition and rain-out of ^{90}Sr at nine collecting stations increased to new high levels, 1.31 mC/km^2 and 3.7 pC/l, respectively. The average ^{90}Sr and ^{137}Cs levels in milk from eight collecting stations similarly reached new highs, 15.9 strontium units (pC/g Ca) and 64 pC/g K, respectively. The potential health hazard is evaluated, and it is concluded that the ^{90}Sr average in milk is 2.2% of the permissible level for the whole population. (D.L.C.)

9372 STRONTIUM-90 AND ^{137}Cs IN THE DIET AND URINE OF THE INFANT POPULATION OF ROME. A. Cigna, A. Ferro Luzzi, A. Mariani, M. A. Spadoni, and G. Tomassi (Istituto Nazionale della Nutrizione, Rome). Boll. Soc. Ital. Biol. Sper., 39: 2121-2(Dec. 31, 1963). (In Italian)

A study of 60 children of both sexes aged 4 to 7 yr revealed that levels of ^{90}Sr (as pC/g Ca) and ^{137}Cs (as pC/g K) in urine were higher than in the diet. This indicates a preferential elimination of these radionuclides through the urine. The relation between the urine and diet levels of these radionuclides, especially with regard to ^{90}Sr differed from that found in adults. (BBB)

9373 THORIUM AND URANIUM CONTENTS OF SOME SANDSTONES. John J. W. Rogers and Keith A. Richardson (Rice Univ., Houston, Tex.). Geochim. Cosmochim. Acta, 28: 2005-11(Dec. 1964).

Average values were obtained by gamma spectrometry for the thorium and uranium contents of some orthoquartzites and graywackes. The Atoka and Jackfork quartz sandstones of western Arkansas averaged approximately 4 ppm thorium and 1 ppm uranium. The Umpqua and Tyee graywackes of western Oregon averaged approximately 7 ppm thorium and 2 ppm uranium. Weighted average concentrations for all sandstones were 5.5 ppm thorium and 1.7 ppm uranium. Much of the radioactivity, particularly in the graywackes, was carried by heavy minerals such as biotite and zircon. The average concentrations in sand-sized material were therefore, lower and could be estimated as 3 ppm thorium and 1 ppm uranium. Sand-sized quartz and other minerals deposited in hydraulic equilibrium probably had average concentrations in the neighborhood of those of the Atoka and Jackfork orthoquartzites, namely: 4 ppm thorium and 1 ppm uranium. (auth)

9374 RADIOBERYLLIUM IN FOSSIL BONES. V. V. Cherdyntsev, T. A. Ibraev, and V. F. Moshalova (Geological Inst., Moscow). Geokhimiya, No. 12, 1240-3(Dec. 1964). (In Russian).

A high radioberyllium content was detected in fossil bones. Its specific activity (Be^{10}/Be^{9} = 2.4 × 10^{-4}) was higher than for other terrestrial samples. It was concluded that the isotope is probably introduced during the secondary mineralization and its content does not depend on age. (auth)

9375 ON SOME REGULARITIES OF RADIUM DISTRIBUTION IN UNDERGROUND WATERS OF THE MIDDLE PART OF THE DNEPR-DON DEPRESSION. L. K. Gutsalo (Inst. of Geology and Geochemistry of Combustible Minerals, Lvov). Geokhimiya, No. 12, 1305-12(Dec. 1964). (In Russian).

The radium distribution in underground waters of Paleozoic and Mesozoic deposits of the Dnepr-Don depression was investigated. It was established that in sheet waters of the natural radiohydrochemical background the radium accumulation is bound by a straight linear dependence to the general mineralization of waters. The level of the natural radium background of underground waters, expressed by the coefficient of relative radium saturation, (Ra · 10^{12})/M, changed from 2.51 to 4.43 in water-bearing stages of the Paleozoic and from 0.80 to 1.70 in sheet-waters of the Mesozoic deposits. In underground waters in contact with oil and gas deposits, an increase of relative radium concentration was observed. The value of the relative radium saturation of underground water, (Ra · 10^{12})/M, of the Paleozoic deposit exceeding 4.5 and of the Mesozoic deposit exceeding 2, may be considered as a hydrochemical indicator of oil content in the interior parts of the region under investigation. (auth)

9376 ^{90}Sr IN DIET AND BONE OF SAN JUAN, PUERTO RICO AND NEW YORK CITY RESIDENTS. J. Rivera (Atomic Energy Commission, New York). Ind. Med. Surg., 33: 494-5(July 1964).

The ^{90}Sr/Ca ratio of human vertebrae from accident victims in San Juan, Puerto Rico, averaged 1.1 pC/g for 68 samples collected from Jan. 1, 1961 to June 30, 1962. In New York City, 80 vertebrae specimens averaged 1.2 pC/g during this time period. The similarity of the ^{90}Sr concentrations in bone observed in the two cities is remarkable since the fallout and presumably the contamination of foods with ^{90}Sr is lower in San Juan than in New York. The fallout of ^{90}Sr during this period in New York was 20.2 mC/mi^2 and in San Juan only 14.5 mC/mi^2. In June 1961, and Aug. 1962, foods thought to be typical of those consumed by low income residents of San Juan were obtained and analyzed for ^{90}Sr and Ca. Estimates of the relative per capita consumption of these foods were made and the total average yearly intake of ^{90}Sr and Ca was calculated. The average intake of ^{90}Sr in June 1961, was found to be 1340 pC/yr and in August 1962, it was 1900 pC/yr. The Ca intake averaged 185 g Ca/yr for the two samplings. Estimates of the intake of ^{90}Sr and Ca by New York City residents were made every three months since March 1960. For the period from January 1961, to June 1962, the intake of ^{90}Sr was virtually constant in New York and averaged 4200 pC/yr, while the Ca intake averaged 383 g/yr. Despite the differences in ^{90}Sr intake at San Juan and New York City the ^{90}Sr/Ca ratios of the diet were about the same at the two cities, being about 9 pC/g in San Juan and 11 pC/g in New York. The similarity of ^{90}Sr/Ca ratios in vertebrae obtained at the two cities is therefore ascribed to the similarity in the ^{90}Sr/Ca ratios of the diet at the two cities. These findings suggest that ^{90}Sr/Ca ratios in bones of low-Ca consuming populations may be higher than might be expected from their ^{90}Sr intakes alone. (BBB)

9377 X-RAY ANALYSIS OF RADIOACTIVE FALLOUT OVER CALCUTTA. Prabir K. Sandell, J. Mukherjee, and Sushil K. Das (Jadavpur Univ., Calcutta). Indian J. Phys., 38: 376-8(July 1964).

Since 1961, fallout over Calcutta was collected and classified into three groups: airborne particles deposited on dry days, the insoluble residue of filtrates of rainborne dust, and the residue after evaporation of the filtrate to dryness. Sample x-ray spectra are given for each of the groups. (M.J.T.)

9378 CATTLE AS FALLOUT MONITORS: IODINE-131 IN BOVINE THYROID GLANDS FROM 1957 THROUGH 1961. Clifton Blincoe (Univ. of Nevada, Reno), V. R. Bohman, and E. L. Fountain. J. Agr. Food Chem., 12: 414-19 (Sept.-Oct. 1964).

Thyroid ^{131}I concentrations of cattle maintained in desert environments under a variety of fallout conditions are reported. Categories of cattle included cattle maintained on desert range areas in Nevada, and cattle slaughtered by a packing plant in Reno, Nev. One herd grazed areas of the Nevada Test Site of the U. S. Atomic Energy Commission usually east of those areas used for nuclear research. Another herd was about 30 miles east of the Nevada Test Site boundary. A third herd was far north of the nuclear test sites. In the absence of nuclear weapons tests, a small, uniform concentration of ^{131}I was found in the thyroid glands of range cattle. In Reno slaughter cattle, this level was found to be about 1 pC/g. Range cattle tended to be slightly higher, these differences probably reflecting different dietary conditions. Possible sources for this ^{131}I include unannounced testing of nuclear weapons, natural production of ^{131}I, and release of reactor produced ^{131}I to the atmosphere. The constancy of the 1959 and 1961 data on Reno slaughter cattle tend to rule out unannounced testing as a source, and natural production of ^{131}I probably does not account for the consistency of the 1959 and 1961 data. The release of reactor-produced ^{131}I to atmosphere appears to be the most probable source of the constant low level of ^{131}I observed in the bovine thyroid glands sampled. Iodine-131 from nuclear weapons tests at considerable distances from Nevada gave variable results, depending on local weather patterns. The French test of February 13, 1960, was detected in Reno slaughter cattle. In one experiment cattle were moved to forage in an area in which atmospheric nuclear weapons tests (low yield) took place immediately before. The thyroid dose resulting from grazing this highly contaminated range was estimated to be in the range of 50 to 100 rep. No gross or histological abnormalities were observed in this herd, and cattle were safely grazed in the ground-zero area immediately after a low yield nuclear detonation. It is suggested that the thyroid gland of ruminants (especially range cattle) is the most sensitive indicator of ^{131}I in the biosphere. The use of slaughter cattle for study of fallout ^{131}I concentrations offers both advantages and disadvantages as compared to range or pasture cattle. From the standpoint of the study of maximum fallout accumulation by animals, it is preferable to sample range or pasture livestock. From the standpoint of public health the level of fallout contaminants in slaughter cattle is of most interest. (BBB)

9379 CANADA'S RADIOACTIVE FALLOUT STUDY PROGRAM. P. M. Bird (Dept. of National Health and Welfare, Ottawa). J. Can. Assoc. Radiologists, 15: 74-8(June 1964).

The Department of National Health and Welfare of Canada has been conducting a study of radioactive fallout with the object of assessing its significance to the health of Canadians. The scope of this program, including its objectives and limitations of assessment, are discussed. An analysis of the factors considered in planning this fallout study program showed that the most reliable public health radiation dose assessment could be made from measurements of the fallout component in the sensitive tissues directly. The next most reliable dose assessment can probably be made from measurements of the fallout component at the stage just prior to incorporation into the body. Tables are given which summarize the various studies in existence and planned as part of the overall program of the Radiation Protection Division, including estimates of radiation dose to sensitive tissues, indirect estimates of radiation dose, and a forecast of future levels. Other tables showing the 1963 summary of the monthly average fallout levels indicate that the average levels in the different studies reached peak values at various times during the year but that by the end of the year a general downward trend had begun. This is consistent with the experience found in 1959 after the cessation of testing in October, 1958. Results to the end of 1962 show that the highest average concentration of ^{90}Sr in bone was somewhat less than 4 pC/g Ca in the 6 to 9 yr age group. The ^{90}Sr values obtained in both wheat and soil studies followed the expected pattern. Wheat levels decreased steadily during the moratorium of 1958 to 1961 and rose again sharply to the highest ever recorded in the 1962 samples. The 1963 levels may be even higher. Soil values remained relatively constant in 1960 and 1961 reflecting the fact that relatively small amounts of ^{90}Sr were deposited during the intervening year. By 1962, the soil levels had increased somewhat, reflecting the beginning of the deposition of additional amounts of ^{90}Sr from the new test series initiated in September 1961. A maximum permissible concentration for ^{90}Sr in the lifetime diet of an average Canadian was calculated to be 79 pC/g Ca. The highest monthly overall average concentration in milk so far observed has been about 40 and the highest year-long average concentration about 25 pC/g Ca. Similarly, the observed ^{137}Cs levels were shown to be a much smaller fraction of the calculated maximum permissible concentration. (BBB)

9380 URANIUM AND THORIUM SERIES IN EQUILIBRIUM IN SEA WATER. Willard S. Moore and William M. Sackett (Columbia Univ., Palisades, N. Y.). J. Geophys. Res., 69: 5401-5(Dec. 15, 1964).

Sea water samples of 130 to 190 liters were collected to measure the concentration of thorium and protactinium in the ocean. After concentration at sea and chemical isolation of the elements in the laboratory, the various isotopes were resolved with an α-particle spectrometer. The precipitation of ^{230}Th and ^{231}Pa as they are formed from uranium was found to be essentially quantitative, less than 0.05% of the ^{230}Th and less than 0.2% of the ^{231}Pa remaining in solution. All thorium isotopes seem to be more concentrated in the one sample of North Atlantic bottom water than in several samples of surface or intermediate waters. An activity ratio of 15 was observed for ^{228}Th/^{232}Th at all depths. This ratio is probably due to a partial solution of ^{228}Ra as it is formed from ^{232}Th in the sediment and/or river contribution of ^{228}Ra. The presence of excess ^{228}Ra in coastal waters was confirmed by measurements made on samples of shell material. (auth)

9381 AVERAGE LEVEL OF ^{90}Sr IN THE DIET OF THE CITIZENS OF BOLOGNA. M. Zanetti. (Università, Bologna). Riv. Ital. Igiene, 22: 226-37(1962). (In Italian)

The daily dietary ratio of ^{90}Sr/Ca (as pC/g Ca) and amount of ^{90}Sr ingested per day (as pC) for various dietary staples by residents of Bologna were determined. On the basis of previously published estimates, the actual absorption of ^{90}Sr from such a diet was calculated to be about ¼ of the total amount ingested, or about 3.4 pC Sr/g Ca daily. These figures for ^{90}Sr content of the Bologna diet are comparable to those obtained in other countries such as the United States and England. Possibilities of reducing the ^{90}Sr intake, such as by increasing Ca content of the diet and removal of ^{90}Sr, are discussed. The results tend to confirm earlier studies showing that the higher the level of milk and milk products in the diet, the lower the absorption of ^{90}Sr. Data are also presented on the average composition of the Italian diet. Comparative figures are included on the relative importance of cereals, vegetables, meats, and milk in the diets of Italy, Japan, and the United States. (BBB)

9382 MEASUREMENT OF LONG-LIVED RADIOACTIVITY OF ATMOSPHERIC DUST IN THE YEAR 1961. Gertrud Keck (Tierarztliche Hochschule, Vienna). Wien. Tieraerztl. Monatsschr., 49: 633-46(1962). (In German)

Studies on atmospheric radioactive dust during 1961 in Vienna are reported. No long-lived radioisotopes were found during the first 8 months. After Sept., when atmospheric nuclear tests began, an increase in long-lived radioisotopes in atmospheric dust was recorded. Gamma spectrometry revealed the presence of ^{141}Ce, ^{144}Ce, ^{103}Ru, ^{95}Zr, and ^{95}Nb. Other particles of greater activity were also observed. (J.R.D.)

9383 MEASUREMENT OF LONG-LIVED RADIOACTIVITY OF ATMOSPHERIC DUST IN THE YEAR 1962. Gertrud Keck (Tierarztliche Hochschule, Vienna). Wien. Tieraerztl. Monatsschr., 51: 301-16(1964). (In German)

Measurements of long-lived radioisotopes in atmospheric dust at stations in Austria during 1962 are recorded. Gamma spectrometry was used to identify ^{141}Ce, ^{144}Ce, ^{103}Ru, ^{95}Zr, ^{95}Nb found during the entire year. ^{147}Nd was found from August on and ^{140}Ba, ^{140}La, and ^{131}I from Sept. on. One sample contained ^{132}Te. (J.R.D.)

Techniques and Equipment

9384 (AD-442907) FINAL REPORT TO DEFENSE ATOMIC SUPPORT AGENCY, FEBRUARY 1, 1963–MARCH 31, 1964. W. M. Adams, J. W. Hawes, and N. L. Nuhn (Planetary Sciences Ins., Santa Clara, Calif.). Mar. 2, 1964. Contract DA-49-146-XZ-186. 44p.

Methods for analyzing digitized strong-motion seismograms have been selected and developed. These techniques have been programmed for one of three different electronic digital computers, the IBM 1620, CDC 1604, or IBM 7094. The codes have been debugged and checked by manual calculations or test problems, then used to run production on existing data. Emphasis has been on utilization of the general frequency and time-dependent aspects of the entire trace, rather than simply times-of-arrival, maximum amplitudes, or dominant period of maximum amplitude. Alternate methods of presenting the information in a trace by automatic plots have been developed and compared. An attempt to use numerical-control machining for generation of complex ultrasonic methods has been unsuccessful but the approach merits continued effort. Dominant use of the analyses has been an operations research approach to planning field programs that utilize existing seismic data. (auth)

9385 (NP-14531) DETECTION OF DISTANT EXPLOSIONS BY SEISMIC MEASUREMENTS IN DEEP BOREHOLES. Semiannual Report No. 1. Donald R. Van Sandt (Jersey Production Research Co., Tulsa, Okla.). Oct. 19, 1961. Contract AF19(604)-8346. 16p. (VESIAC-2131-VU).

Activities directed toward determining whether seismic data recorded in cased holes are comparable to those in open holes are reported. The method used was to compare data recorded simultaneously in cased and open boreholes. Results are presented that lead to the conclusion that earth movements can be satisfactorily recorded in either uncased or completely cemented cased holes using lock-in type geophones. (J.R.D.)

9386 (UCRL-Trans-1106(L)) EFFECT OF SHORT-DELAY BLASTING ON THE EXTENT OF THE SEISMIC EFFECT OF LARGE-SCALE EXPLOSIONS. B. V. Pozdnyakov, Yu. V. Nelyubov, A. K. Serdyukov, Yu. P. Zhuiko, and M. G. Sedlov. Translated by Sergey Shewchuck (Univ. of California, Lawrence Radiation Lab., Livermore), from Gorn. Zh., No. 8, 25-8(1963). 10p. Dep.(mn); $1.00(cy), 1(mn) OTS; $1.10(fs), $0.80(mf) JCL.

The geological seismical situation in the ore field region of the Zyryanovski mineral bed is very complex, and is explained by the cut-up or dissection of both the surface as well as the deep part of the massiv by mining works, and by the presence of flood depositions of variable width. This circumstance brought about a sharp difference (of 1.85 times) in the oscillation intensity for the two groups of profiles. Optimal parameters of short-delay blasting assure a considerable reduction in the oscillation intensity as compared with instantaneous blasting or explosion, which permits a five-times increase in the total weight of the charges to be exploded simultaneously without changing the seismic effect. For the conditions of the Zyryanovski open pit the optimal parameters for short-delay blasting, using the standard means of explosion, are: a delay interval of not less than 25 m sec and number of orders not less than 3. (auth)

9387 NEW DATA OF THE ABSOLUTE AGE DETERMINATION OF SOME GEOLOGICAL FORMATIONS OF THE AMAZAR-SHILKA INTERFLUVE (EAST TRANSBALKAL). V. P. Kirilyuk, E. M. Leifman, A. A. Sivoronov, G. H. Chedzhemov, G. P. Mamchur, and O. V. Ts'on. (Iv. Franko State Univ., Lvov). Geokhimiya, No. 12, 1244-55(Dec. 1964). (In Russian).

Age determinations of 32 samples from crystalline rocks of the Lower Proterozoic folded area, activated in the Permian and Jurassic periods, showed the possibility of a successful use of the potassium-argon method for subdivision of post-proterozoic rocks of the region according to their age. The lower proterozoic rocks undergo a regional "rejuvenation" with a radiogenic argon loss in the period of 248 to 155 million years. Among younger formations Permian (238 to 246 million yr) and Jurassic magmatic rocks are outstanding. A part of the latter consists of lower and middle Jurassic intrusive formations (155 to 196 million yr), upper Jurassic effusives (150 ± 8, 150 ± 9), and hypabyssal (132 to 157 million yr) rocks. Radiological data agreed well with the results of geological observations. (auth)

9388 STUDY ON RADIOCARBON DATING. 2. IMPROVEMENTS OF THE METHOD AND DATING RESULTS. Tatsuji Hamada and Chikako Fujiyama. Rika Gaku Kenkyusho Hokoku, 40: 309-14(1964). (In Japanese).

Thorium and Uranium Minerals

9389 (RME-4551) VILCABAMBA URANIUM DEPOSITS, CUZCO DEPARTMENT, PERU. John W. Gabelman (Division of Raw Materials, AEC and Peru. Junta de Control de Energia Atomica, Lima). Oct. 1962. 28p. Dep.; $2.00(OTS).

In 1957 uranium was discovered in the Vilcabamba district on the north flank of the Cordillera Vilcabamba, part of the Cordillera Oriental. This district contains principally small copper-nickel veins. Small lenses of uraninite occur in calcite veins cutting Permian Copacabana limestone. Uranium is most abundant marginal to centers of strongest copper-nickel mineralization. Leaching and oxidation are virtually absent because of Pleistocene glaciation. Four separate areas in which uranium has been identified are Huamanapi, Calderón, Minasmayo, and Negrillas. The Puntarayoc area, near Pampaconas, is considered a separate district. The deposits have been tested by trenching, drilling, and sampling concurrently with geologic reconnaissance mapping of the surrounding region. (auth)

9390 NATURAL RADIATIVE DAMAGE IN URANIFEROUS ASPHALTIC MATERIALS. I. ASPHALTIC SANDSTONE OF MAS ALARY (HERAULT, FRANCE). J. Jedwab. Bull. Soc. Belge Geol., Paleontol. Hydrol., 71: 487-96(1963). (In French)

The mineralogy of the asphalt sandstones of Mas Alary was studied. It was found that there are asphalt grains sharply differing in their reflecting power and their properties in polarized light. The grains with low reflecting power usually contain pitchblende inclusions. The complexity of the optical effects around these inclusions (halos with redoubled contours and plastic structures) were attributed provisionally to the superposition of the following effects: condensation of liquids and gases by irradiation, plastic and brittle movements, and effects of halo, anisotropization, and hardening on the microscopic scale by irradiation. (J.S.R.)

9391 NATURAL RADIATIVE DAMAGE IN URANIFEROUS ASPHALTIC MATERIALS. II. ASPHALTIZED FOSSIL FORESTS OF TEMPLE MOUNTAIN (UTAH). J. Jedwab (Universite Libre, Brussels). Bull. Soc. Belge Geol., Paleontol. Hydrol., 72: 401-9(Dec. 17, 1963). (In French)

Microscopic observations on the distribution of uranium and the optical effects it caused in a sample of fossil wood are reported. The technique of graphic marking is described in detail in an appendix. Two types of opaque organic formations were observed. The minerals forming the nucleus of the halos were not identified with certainty The fine structure of the irradiation halos and distribution of the α activity are described. (J.S.R.)

9392 A NEW MINERAL SPECIES: COMPREIGNACITE, $K_2O \cdot 6UO_3 \cdot 11H_2O$. J. Protas (C.N.R.S., Bellevue, France and Laboratoire de Mineralogie-Cristallographie, Sorbonne, Paris). Bull. Soc. Franc. Mineral. Crist., 87: 365-71(July-Oct. 1964). (In French)

The crystallographic characteristics of compreignacite were determined and are reported. It is orthorhombic with a = 7.16 ± 0.02, b = 12.16 ± 0.05, and c = 14.88 ± 0.05 Å. The powder diagram lines were tabulated. Chemical analyses were made using a Castaing electron microprobe on the natural samples and using classical methods on the artificial sample. The water of hydration was rapidly lost beginning at 60°C and the anhydride was formed at 480°C. (J.S.R.)

9393 NUCLEAR FUELS IN JAPAN AND IN THE WORLD. Kosaburo Takahashi. Nippon Kogyo Kaishi, 79: 519-24(1963). (In Japanese)

The uranium production in such countries as Canada, U.S.A., South Africa, Australia, and Japan is discussed with reference to uranium resources of those nations. In the United States of America, prospecting for vein type deposits formed in the Pre-Cambrian was not successful in the early days of the uranium hunt. However, after 1958, a number of sedimentary type uranium deposits were discovered. In Japan, prospecting was first concentrated on the vein type deposits around Okayama and Tottori prefectures and then on the sedimentary type. Ningyo-toge and Togo deposits were discovered and the total ore reserves of the country are now estimated at 2,871,000 tons. Uses of uranium are outlined. In order to meet the sharp increases in energy demands, a considerable amount of uranium is needed. Natural uranium is also used to produce plutonium. (auth)

9394 THE CHARACTERISTICS OF THE URANIUM DEPOSITS IN SEDIMENTARY ROCKS IN JAPAN. Motoo Satō and Fumio Togo. Nippon Kogyo Kaishi, 79: 525-30 (1963). (In Japanese)

Promising uranium deposits were discovered in sedimentary rocks in massif regions. The uranium mineralization was observed in the black shale beds of Paleozoic age related to the bedded manganese deposits. These deposits are considered the potential resources at present. In Japan the most important deposits, such as Ningyô-tôge deposits, Oguni and Kanamaru deposits, Okutango deposits, and Tônô deposits, are those of the ground-water type. It was concluded that the uranium in ground water, derived from granitic rocks, was precipitated under reducing conditions, after deposition of the conglomerate, the sandstone, and the mudstone of Neogene Tertiary age. Considering the ages of these ore deposits and the environments of deposition of their host rocks, it can be said that wide areas with the sedimentary rocks of the same type remain unexplored. Studies of characteristics of the ores of Ningyô-tôge proved that they have good quality and their treatment is very easy, in spite of its relatively low grade in comparison with foreign ores. (auth)

9395 THE CHARACTERISTICS OF THE NINGYÔ-TÔGE URANIUM ORES FROM THE STANDPOINT OF MINERAL ASSOCIATION. Motoo Satō, Fumio Tōgō, and Kazuhisa Nozawa. Nippon Kogyo Kaishi, 79: 531-6(1963). (In Japanese)

Uranium ores of the Ningyô-tôge deposits exist in Neogene Tertiary beds of low cementation such as conglomerate, arkose, mudstone, and tufaceous rocks. These ores are soft and porous, and the uranium minerals occur as fine grained crystals in the matrix of the conglomerate, on the surface of the pebbles in a skin like manner, or in cracks. These characteristics of the ores render their mechanical treatment very simple. The grade of ore can be raised several times by washing with water and screening, and the quantity of ore to be treated by chemical means can be greatly reduced. In addition this enables hydraulic mining, which greatly reduces the cost of mining and transportation. In extracting uranium from ores, the leaching acid is readily permeable and contact with the uranium minerals is rapid and sufficient. The main uranium mineral of the deposits, ningyonite, is easily soluble in acid in spite of its tetravalent uranium. Therefore, the ores of Ningyô-tôge showed higher extraction under milder conditions than other ores. Since the amount of carbonate minerals in the ore is negligible, the consumption of acid is small. In Ningyô-tôge ore, there are almost no minerals that contain elements that interfere with the process of ion exchange and solvent extraction during refining. In addition, the yellow cake and metallic uranium manufactured from the Ningyô-tôge ore contain smaller amounts of elements that have high cross sections for neutron absorption in comparison with imported yellow cakes and metallic uranium manufactured from them. A method of direct refining is described, which is an attempt to bypass the intermediate stage of manufacturing yellow cake and to directly produce UF_4 of high purity. (auth)

9396 ON THE URANIFEROUS SHALE BED OF NAKATSUGO ORE DEPOSITS, NINGYÔ-TÔGE MINE: OKAYAMA PREFECTURE. Masaaki Suginohara and Takaharu Okuno. Nippon Kogyo Kaishi, 79: 537-42(1963). (In Japanese)

The Nakatsugo area of the Ningyô-tôge mine consists of the coarse-grained biotite granite of the basement rock, and the unconformably overlying sedimentary rocks, andesitic lavas, and their pyroclastics of the Tertiary period. Uranium deposits are usually developed in basal conglomerate and arkose sandstone just above the unconformity plane, but in parts of Nakatsugo deposit uranium minerals were precipitated in shale bed lying concordantly on basal conglomerate and arkose sandstone. They were deposited along the lamination or stratification in comparatively coarse parts. Generally uranium content in the shale was less than 0.05% U_3O_8, but in some parts it was more than 0.1% U_3O_8. There was positive correlation between uranium and sulfur contents, but there was little correlation between uranium and phosphorus or arsenic and carbon contents. These facts indicated that uranium mineralization is related especially to sulfide minerals. The main uranium mineral in shale type deposits of Nakatsugo was not ningyonite. (auth)

9397 THE URANIUM DEPOSITS OF TÔGÔ MINE OF NINGYÔ-TÔGE URANIUM FIELD. Ryuji Sugiyama, Gakuji Sato, Kiyoshi Kikuchi, and Isao Hukuoka. Nippon Kogyo Kaishi, 79: 543-53(1963). (In Japanese)

In the area of the Tôgô mine of the Ningyô-tôge uranium field, there are three types of granite, Okutsu, Ningyô-tôge, and Ogamo. Nearly horizontal strata of Misasa group of Neogene Tertiary lie uncomformably on these granites and this group has three cycles at the point of volcano-stratigraphy. Uranium was deposited in the lower beds of Misasa group, and its location was controlled by the channel structure on the surface unconformity of the granites. Uranium was mainly found in basal conglomerate and arkose, and rarely in shale, tuff, etc. Ore grade was 0.07 to 0.10% U_3O_8. Several uranium minerals were found: ningyonite, uraninite, and coffinite as the primary minerals and autunite, β-uranophane, etc. as the secondary minerals. It was concluded that these uranium deposits are epigenetic and uranium was deposited from underground water. (auth)

9398 THE EXPLORATION TECHNICS OF THE URANIUM DEPOSITS IN SEDIMENTARY ROCKS IN JAPAN. Motoo Satō, Ichirō Kaku, and Eizō Nakamura. Nippon Kogyo Kaishi, 79: 554-67(1963). (In Japanese)

For exploration and prospecting of Ningyō-tōge uranium deposits, the most efficient and effective methods were reviewed with consideration for the characteristics of the deposits. Seismic prospecting methods were found to be most successful, as proved by drilling operations. Since the Ningyō-tōge deposits have the rule of channel structural control, that is, the deposits occur in the basal parts of the Neogene formation sedimented on depressions of the granite basements, seismic prospecting could be successfully applied. Applications of the electric prospecting method and the joint use of the electric and geochemical prospecting method as well as the seismic prospecting method are described. Similar special considerations were given to geochemical prospecting for research on tributary water and soil. Prospecting by drilling was conducted in order to grasp rapidly the potentialities of the mineral resources such as uranium. (auth)

9399 A PROSPECTING METHOD OF URANIUM ORE BY THE SIMPLE BORING MACHINE AT TÔGÔ MINE. Shunzō Takenaka and Ichiro Iwata. Nippon Kogyo Kaishi, 79: 568-72(1963). (In Japanese)

The sedimentary uranium deposit at Asabatake district, Tôgô mine, occurs in arkose sandstone in a tuff bed over the granite base. The bottom of the channel formation is rich in uranium. Simple boring underground was found to be the best way to prospect because it is cheaper. The boring machines were of three types: the TAP-1 boring machine could be driven 30 to 50 m in depth. It was difficult to remove from place because of its heavy weight, but the drilling speed is very high and stable. The portable borer was capable of 10 to 30 m in depth. These machines were used with hollow round steel rods of 1 m × 28 mm. The leg auger was driven to 5 m in depth with a spiral rod. Counting rates are related to uranium ore grade. Adaptability to estimation of ore reserves, working efficiency, and costs are discussed. (auth)

9400 FERROUS ION AND URANIUM CONCENTRATIONS AND DISTRIBUTIONS IN 100 SELECTED LIMESTONES AND DOLOMITES. Robert W. Deininger. Thesis, Houston, Tex., Rice Univ., 1964. 92p.

One hundred samples of limestone and dolomite were analyzed for calcium, magnesium, ferrous ion, and uranium. The uranium was determined fluorimetrically and the other ions by versenate titration. The ferrous carbonate content of the samples ranges up to 7.9 mole percent with a median value of 0.06 mole percent. Uranium concentrations range from 0.03 ppm to 2.0 ppm by weight. Samples were obtained from Michigan, Jamaica, Missouri, Wisconsin, Nevada, and Texas. The ferrous ion distribution is directly related to that of the dolomite. The distribution of uranium is believed to be related to the calcium to uranium ratios in the media of crystallization and/or recrystallization. Mineralogy may not affect uranium distribution. Inorganically precipitated carbonates may contain more uranium than those precipitated organically. The average calcium to uranium ratios in limestones, sea water, and other natural waters are very similar. Precipitation experiments indicate that the calcium to uranium ratio, not the temperature or the absolute uranium concentration, controls uranium uptake by calcite. The calcium to uranium ratio in the solution is found to be about 1.4 times that in the precipitate. The experiments also suggest that the uranyl ion substitutes for calcium. The uranium distribution in the natural samples indicates that uranyl ion may also substitute for magnesium in dolomite. Mechanisms for the substitution of uranyl ion in calcite are proposed. (Dissertation Abstr., 25: No. 3, Sept. 1964)

9401 HYDROGEOCHEMISTRY OF URANIUM IN THE BANCROFT-HALIBURTON REGION, ONTARIO. Geological Survey of Canada Bulletin 118. J. A. Chamberlain (Canada. Dept. of Mines and Technical Surveys). 19p., 1 map. $1.00(Geological Survey of Canada, Ottawa).

A hydrogeochemical study of U in a 2000-mile area centered on Bancroft, Ontario was conducted to obtain information regarding concentrations of U in natural waters. The investigation was conducted to evaluate hydrogeochemical prospecting methods. It was concluded that U ore bodies in this area will escape detection using hydrogeochemical methods of prospecting, however the technique may be useful in outlining load zones for additional exploration. (J.R.D.)

HEALTH AND SAFETY

Refer also to abstracts 8724, 8859, 8893, 9092, 9283, 9306, 9350, 9368, 9371, 9477, 9478, 10450, 10546, 10549, 10578, 10587, and 10677.

9402 (AD-422319) DEBRIS CLEARANCE STUDY. Final Report. Edward B. Ahlers (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Sept. 1963. Contract OCD-OS-62-202. 226p. $17.50(OTS).

Problems involved in the removal of debris resulting from a nuclear attack on cities are reviewed. Six blocks of a neighborhood business district in Chicago were selected to depict the debris levels likely to exist in outlying commercial districts of major cities or in central commercial districts of smaller cities. Calculated debris levels in these blocks ranged from 1.6 to 7.2 ft with an average of 3.8 ft. Average debris depths calculated for the central business district of Chicago was 12.6 ft. Data are included from estimates of debris depths for streets in various types of neighborhoods. Procedures used for estimating gross debris accumulation and the analysis of blast-wind-induced trajectories of structural fragments are described. Emphasis was placed on estimates of the depths of rubble that may be expected to cover shelter entranceways and transportation arteries. The capabilities of removal equipment and manpower for debris removal are estimated. The effects of fallout on problems of debris clearance are also considered. Emphasis is placed on the need for pre-disaster planning of clearance measures. (C.H.)

9403 (AD-602947) SURVEY OF THE THERMAL THREAT OF NUCLEAR WEAPONS. Jack C. Rogers and T. Miller (Stanford Research Inst., Menlo Park, Calif.). Nov. 1963, Second Printing May 1964. Contract OCD-OS-62-135(III). 431p. $7.31(OTS).

A review is presented of the current state of knowledge on the thermal effects of nuclear weapons, atmospheric transmissivity, ignition of target elements, and fire propagation and spread. Some of the topics considered are: Importance of attack assumptions (delivery capabilities of the enemy, warhead types and yields, altitude of detonation, timing, and warning) in determining the characteristics of thermal radiation and the susceptibility of targets to thermal damage. Modification of the thermal radiation by the atmosphere, intervening cloud layers or other meteorological features, and target elements, such as trees and topography. Interaction of blast, radioactivity, and thermal radiation phenomena. Response of target elements to direct thermal radiation. Effects of weather and topography on target vulnerability and fire spread. Fire development and spread in target areas. Vulnerability of humans. Countermeasures. (auth)

9404 (HW-51934) REPRODUCIBILITY OF PERSONNEL MONITORING FILM DENSITIES. R. H. Wilson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 25, 1957. Contract AT(45-1)-1350. 23p. Dep.(mn); $2.00(cy), 1(mn) OTS.

A study was made of old personnel and calibration film stored over a 13-year period (1944 to 1957). Possible density fading and condition of stored film were evaluated. No appreciable fading occurred, and the film was in good condition except for some dryness and discoloration. Techniques used to interpret radiation dose from film density are discussed. (D.L.C.)

9405 (LA-DC-6804) ANALYTICAL CHEMISTRY IN INDUSTRIAL HYGIENE. H. F. Schulte (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract W-7405-eng-26. 15p. (CONF-641206-1) Dep.(mn); $1.00(cy), 1(mn) OTS.

From Meeting of the St. Louis Society of Analysis, St. Louis.

The important role of analytical chemistry in industrial hygiene is pointed out. The analysis of air samples and biological materials is discussed. Brief histories of the beryllium and plutonium problems, in which extremely sensitive methods were developed, are given. The method used to analyze urine for plutonium is outlined. Other analytical techniques used in industrial hygiene are also considered briefly. (D.L.C.)

9406 (RFP-418) STUDY OF PLUTONIUM OXIDE HEAT GENERATION IN A WOOD MODERATED CONTAINER. J. D. Moseley (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Dec. 28, 1964. Contract AT(29-1)-1106. 29p. Dep.; $2.00 (OTS).

The generation of heat due to the radioactive decay of plutonium in the form of plutonium dioxide stored in wooden containers is considered. The results of two experiments in which plutonium dioxide is placed inside wooden blocks and the temperature rise measured at various points is reported. Heat transfer calculations are then performed to show that the data obtained are those which would be expected, i. e., that Fourier's Law adequately describes the situation. The heat buildup in a proposed wood moderated shipping container is calculated, using some of the assumptions verified in the described experiments. (auth)

9407 (SAM-TDR-64-14) SCATTERED RADIATION FROM A COBALT-60 SOURCE IN A BRICK STRUCTURE. Roger W. Cochran (School of Aerospace Medicine, Brooks AFB, Tex.). June 1964. 8p. (AD-603051) $1.00(OTS)

The scattered component of cobalt-60 radiation produced in a brick structure was determined. An end-window scintillation detector, connected to a 400-channel, pulse-height analyzer, and associated readout equipment were utilized for this study. It was found that 2.7 to 12.4% of the emitted radiation was produced by the brick walls and concrete floor of the magnesium cell. The scatter component can be extremely significant where dosimeters with enhanced low-energy responses are used. (auth)

9408 RADIATION DANGER IN JET FLIGHT. O. C. Allkofer (Christian-Albrechts-Universität, Kiel). Atompraxis, 10: 518-22(Dec. 1964). (In German)

As a result of nuclear tests, the stratosphere was repeatedly contaminated with radioactive fallout material. Owing to meteorological conditions, these fallout particles are accumulated in the stratosphere. Passenger jet planes come into contact with this fallout reservoir on their regular flight routes, which results in contamination of the planes' outer surface and jet machinery. The extent of this contamination depends on the flight route. The possibility of radiation damage (through ingestion) to ground personnel who come into contact with the plane was estimated with particular reference to the higher degree of contamination found in the jet machinery. In addition, an estimate was made of the radiation burden from cosmic radiation in the altitude range (9000 to 12000 m) of present jet flights. (auth)

9409 EXPERIENCE IN MONITORING ARTIFICIAL RADIOACTIVITY IN THE PHOTOGRAPHIC INDUSTRY. Th. Franke (Max Planck-Institut, Frankfurt am Main). Atompraxis, 10: 522-6(Dec. 1964). (In German)

Experiences gained in monitoring artificial radioactivity in the photographic industry are reported. The monitoring included the fission-product activity buried per month by the factories dealt with in the study, as well as the artificial radioactivity present inside the plants and the radioactivity found in the sweepings. The results obtained for 1961/62 showed a discrimination factor of over 100 for the artificial radioactivity found in the plants, as compared with outdoor values. Taking an activity of 10^{-13}C/deposit in the film emulsion, which is considered permissible, and using the discrimination factors obtained, permissible values are given for the fission-product activity buried per month if all undue risk is to be avoided. The influence of contamination from the air is also discussed. (auth)

9410 ELEMENTS FOR EVALUATION OF RISKS OF OPERATION OF A RADIOCHEMICAL PLANT. Baldomero Lopez Perez (Junta de Energia Nuclear, Madrid), Silvio Cao, and Paul Amaury. Energia Nucl. (Madrid), 8: 25-40 (July-Sept. 1964). (In Spanish)

The factors to be considered in evaluating risks in the operation of a radiochemical plant (principles of secondary containment, effects of an explosion within a hot cell, types of chemical explosions, detonations, physical properties of aerosols, meteorology, and dose evaluation) are discussed. These factors are then applied to the analysis of the risks in fuel reprocessing plants. (J.S.R.)

9411 SAFETY AND HEALTH IN THE URANIUM MINES OF THE FRENCH ATOMIC ENERGY COMMISSION. J. Chameaud. Evolution Med., 7: 29-33(Jan.-Mar.).

There are two types of radiation hazard in uranium mines: external gamma irradiation and internal contamination through the inhalation of radioactive substances. Radioactivity, which is in addition to the silicosis hazard, often involves the same protective measures: wet drilling; water sprays after firing and during loading; and intensive ventilation. To limit radiation sources, roadways are not driven through ore-bearing rock; abandoned workings are hermetically sealed; ore transportation, rock haulage, mine drainage, and air circulation are all accelerated. Technical measures have been linked with personnel education and have given good results. If work entails exposure to high concentrations of radon, workers wear airline hoods; length of exposure has been calculated to keep below the average dose of 5 Rem/year whole-body irradiation. Medical measures include initial and periodical medical examinations and systematic blood tests. These measures have considerably reduced the silicosis hazard, and no radiation damage has been recorded. (Occupational Safety Health Abstr., 2: No. 1, 1964)

9412 PROBLEMS ON THE USED NUCLEAR FUELS. Fujio Sakauchi (Science and Technics Agency, Tokyo). Genshiryoku Hatsuden, 8: 3-9(Mar. 1964). (In Japanese)

The JPDR (Japan Power Demonstration Reactor) started operation, producing the nation's first electric power from atomic energy, in October 1963. The Tokai power station is scheduled to start generating electricity in April 1965. With several research reactors and other power reactors, already in operation or to be constructed, the problems of spent fuels from these reactors will become important. The nation's policy toward spent fuels, storage of the spent fuels, casks and other transport containers for the transport of the spent fuels, problems arising in transport of the spent fuels, laws and regulations, costs of transporting the spent fuels, and utilization of the plutonium produced are discussed. (NSA of Japan)

9413 PROBLEMS ON THE TRANSPORTATION OF THE USED FUELS. Tomoo Otsubo (Mitsubishi Shoji Kaisha, Ltd., Japan). Genshiryoku Hatsuden, 8: 24-31 (Mar. 1964). (In Japanese)

The transportation of spent fuels from Japan to America is discussed. Nuclear fuels are shipped after cooling for certain periods for decay of radioactivities. The transport casks used must be strong and airtight, and must be so designed as to facilitate dissipation of heat generated in the fuel. Compensation must be made for damages to transporting devices, crews, loaders and unloaders, as well as to the public, during transportation. In the transportation of used fuels, some agreement with the laborers engaged in the transport is necessary. The trend in the size of transport casks is to make them larger from the standpoint of transport economy. But, this trend is in conflict with present regulations on ship transport. (NSA of Japan)

9414 EXPERIMENTS ON THE SURFACE DEPOSITION OF AIRBORNE IODINE OF HIGH CONCENTRATION. J. F. Croft, R. E. Davis, and R. S. Iles (United Kingdom Atomic Energy Authority, Winfrith, Dorset, Eng.). Health Phys., 11: 1-13(Jan. 1965). (AEEW-R-265; CONF-67-29)

Experiments used to determine the deposition characteristics of airborne iodine released initially as molecular vapor in quantities appropriate to power reactor operation are described. The release was made into a room whose volume was about 30 m^3, in which the walls and special samples were prepared to simulate reactor containment surfaces. The behavior of bare mild steel and concrete, together with a range of surfaces covered with epoxy-resin and chlorinated-rubber based paint, was studied. The conditions in the containment included atmospheres both unsaturated and saturated with water vapor at near ambient temperatures. In the saturated conditions a film of water fully covered the surfaces on which the iodine was being deposited. Equivalent surface concentrations of up to 1 to 2 g/m^2 were produced on mild steel and concrete surfaces, and up to 75 mg/m^2 on painted surfaces, in each case without any apparent saturation effects. Detailed rates of adsorption were evaluated for the range of surfaces, with and without the condensation film, and desorption rates at higher temperatures were also measured. (auth)

9415 DETERMINATION OF COLLECTION EFFICIENCY OF FIBER FILTERS FOR ULTRA-FINE PARTICLES. Jacques Fontan, Daniel Blanc, and André Bouville (Centre de Physique Nucleaire, Faculte des Sciences, Toulouse). Health Phys., 11: 15-20(Jan. 1965). (In French)

Measurements were made on the efficiency of collection of the Schneider-Poelman fiber filters for radioactive particles of diameter of about 0.0015 μ, which are the little ions, recombined or not, coming from the disintegration of the nuclei of radon or thoron, not fixed on the dust particles. The filters then have an efficiency superior to that which corresponds to the atmospheric aerosols. Comparison of the alpha and beta activities, and the alpha spectrometry of the filter, permitted the measurement of the absorption of the aerosols inside the filter. (auth)

9416 RADIOISOTOPES IN THE 1963 DIET. Irving Michelson (Consumers Union of U. S., Inc., Mount Vernon, N. Y.). Health Phys., 11: 56-60(Jan. 1965).

The levels of ^{89}Sr, ^{90}Sr, ^{226}Ra, Ca, ^{137}Cs, K, and PO_4 were determined in samples of teen-age diets in 22 cities in the period from Feb. to Sept. 1963. Methods for the determinations are discussed. The average levels of ^{90}Sr and ^{137}Cs increased steadily from Feb. through July. In terms of total daily intake, ^{90}Sr rose from 30 to 68 $\mu\mu C$, and ^{137}Cs from 125 to 330. These levels were 2 to 3 times as high as the 1962 levels. The average level of ^{89}Sr rose from 95 in Feb. to 145 in June, and fell off rapidly thereafter. Large variations between geographic locations were noted. Daily intake of ^{226}Ra averaged 5 $\mu\mu C$, but varied somewhat with geographic location; average values for individual cities ranged from 2.5 to 6.5 $\mu\mu C$ per day. Potassium and phosphate showed least variation with geographic location; average daily intake values for individual cities ranged from 4.0 to 7.7 g K, and from 6.5 to 12 g PO_4. (P.C.H.)

9417 RECENT TRENDS IN OCCUPATIONAL RADIOLOGICAL HEALTH AND SAFETY. Robert L. Zimmerman (Georgia Inst. of Tech., Atlanta). Ind. Med. Surg., 33: 491 (July 1964).

Increasing hazards associated with the increased occupational use of radioisotopes and radiation producing equipment are discussed. The role of U. S. Government agencies, particularly the Atomic Energy Commission, in radiologic health surveillance is considered. The Commission has regulated the use of radioactive materials and radiations associated with and produced by nuclear reactors for more than ten years, but the Congress does not empower the Commission to control the use of other radioisotopes such as radium, or machine produced radiations such as those associated with x ray machines and particle accelerators. The Commission has recently turned over control of all but large quantities of fissionable materials to certain states where inspection and enforcement functions have been satisfactorily established. Those states which have assumed control from the AEC also regulate other radiation sources such as radium and x ray. However, recently the U. S. Dept. of Labor, under the provisions of the Walsh-Healey Act, issued regulations to control the use of all sources of ionizing radiation used by firms with government contracts in excess of $10,000. This will result in enforcement of the regulations in agreement states by not only the state but also the U. S. Department of Labor. It is suggested that existing regulations, such as those of the U. S. Atomic Energy Commission, should be critically reviewed at regular intervals not only by governmental authorities but also by those users subject to the regulations. The review will point out areas where the regulation must be strengthened in addition to suggesting cases where the rules may be safely relaxed in order to achieve maximum utilization of the benefits of radioactivity. Those branches of government administering the radiological safety rules have been responsive to suggestions offered in logical terms by several of the affected users. The development of radiological health services at the Georgia Inst. of Technology, as the result of a major increase in its use of radioactivity in the research and graduate teaching programs, is outlined. (BBB)

9418 RECOVERY AND RESTORATION OF WATER UTILITIES AFTER NUCLEAR ATTACK. Judson A. Harmon and Harvey F. Ludwig (Engineering-Science, Inc., Arcadia, Calif.). J. Am. Water Works Assoc., 56: 1561-77(Dec. 1964).

The destructive effects of a nuclear explosion were studied with relation to various structures, water as it is subjected to treatment processes, and the manpower essential for operation, repair, and maintenance of water supply systems. Few water systems would escape the effects of a nuclear attack in the United States. By advance preparation, strengthening of essential facilities, and development of appropriate systems of procedure, however, utilities could survive in most of the country, where isolation and fallout are the most significant effects. In areas that also experience material damage, minimal water needs for survival could be met initially by using supplies stored in shelters. Utilities would then have sufficient time to carry out preplanned recovery countermeasures. Improvised methods of drawing on emergency sources could be used while essential facilities were being restored. It is essential that water utility officials develop an awareness of the consequences of a nuclear attack, put into effect a program of advance preparation, and maintain a state of readiness. (H.M.G)

9419 THE DAILY INTAKES OF MANGANESE AND IRON BY JAPANESE PEOPLE WITH REFERENCE TO MARINE ENVIRONMENTAL CONTAMINATION WITH RADIOISOTOPES. Noboru Yamagata (Inst. of Public Health, Tokyo) and Toshiko Yamagata. Koshu Eiseiin Kenkyu Hokoku, 13: 11-20(1964).

Measurements were made of manganese and iron in total diet samples collected from many sites to know the normal daily ingestion of these elements by the average Japanese. Two-thirds of urban adults would have an intake of 1.5–2.8 mg (2.12 mg, on an average) and 9–30 mg (19.2 mg), rural adults, 2.0–3.0 mg (2.50 mg) and 9–27 mg (18.0 mg) of manganese and iron, respectively. The daily intakes by Japanese adults as a whole were roughly estimated as 2.3 mg and 19 mg of manganese and iron, respectively. The main contributors of manganese are plant products, especially cereals both in Japan and in the United States. Iron is evenly contributed by different categories of foodstuffs in Japan. This contrasts to a typical diet in the United States in which almost half is contributed by meat, eggs, and milk products. The concept of average concentration factor of an element from sea-water to seafood as a whole was introduced for the evaluation of the marine environmental contamination with radioisotopes as being of value in the planning of radiological protection of people. (auth)

9420 RESEARCH ON THE OCCUPATIONAL EXPOSURE OF WORKERS USING RADIOACTIVE PAINTS IN POLISH INDUSTRY. D. Brykalski, W. Czosnowska, D. Depczyk, A. Gawronski, J. Kiniecki, C. Rozycki, and T. Spodenkiewicz. Med. Pracy, 14: 297-312(1963).

Descriptions are given of the results of medical examinations carried out on 259 workers exposed to radioactive paints in Polish industry. Analysis of the excrement and expired air revealed internal ^{226}Ra or ^{90}Sr contamination, or both, in 65 subjects. In no case did the estimated body burden exceed the maximum permissible level. There was no clinical evidence of radiation injury in any of the workers examined. (Occupational Safety Health Abstr., 2: No. 10, 1964)

9421 RADIOLOGICAL SAFETY IN THE URANIUM MINES IN JAPAN. Hidekatsu Misawa, Michichika Abe, and Kenji Nakajima. Nippon Kogyo Kaishi, 79: 585-9(1963). (In Japanese)

With regard to radiological protection of miners, two types of radiation (external and internal) were measured. The radon gas and its daughters could cause serious radiation hazards in mines. Efforts are therefore being made to reduce the concentrations of radon and its daughters by mechanical ventilation systems. The effects of solid and liquid wastes containing radioactive substances from the mine on surrounding areas were studied, but there was no trouble with regard to radiological health and safety. Measurements of external exposure dose, radon gas, and radioactive dusts and investigations of their control in the two mines are summarized. (auth)

9422 INTERDEPENDENCE BETWEEN DEGREE OF SURFACE DECONTAMINATION AND CONCENTRATION OF RADIOACTIVE AND STABLE ISOTOPES IN CONTAMINATING SOLUTION. Maria Miazek-Kula. Prace Central. Inst. Ochrony Pracy, 14: 231-41(1964). (In Polish)

Investigations were made of the interdependence between the degree of surface decontamination and the concentration, within the contaminating solution, of the radioactive isotopes ^{60}Co and ^{90}Sr (^{90}Y), and of stable isotopes of the same elements. Solutions of different specific activities, varying at the rate 1 : 2 : 4 : 8, as well as solutions of identical specific activities and different concentrations of the stable isotope, varying within the range from 10^{-7} to 10^{-1} mole/liter were used as contaminating agents. Tests were made on samples of glass, vinydurene, vinylene, and rubber, using the following methods of decontamination: immersion in water or in a 0.2 HCl solution, and washing in flowing water and scrubbing with a brush immersed in water or in 0.2$\underline{N}$ HCl. It was ascertained that the interdependence between the degree of decontamination and the concentration of the contaminating solution is greatest when decontamination is made by immersion in water; it was also found that the influence of specific activities is insignificant as to the degree of decontamination. Addition of stable Co isotopes in the form of $CoCl_2$ salts to the solutions, however, increased the degree of decontamination, whereas the addition of Sr (Y) stable isotopes in the form of Sr $(NO_3)_2$ salts to the solution had little effect on the degree of decontamination. (auth)

9423 PREVENTIVE HEALTH CARE IN REACTOR STATIONS. Ph. J. Windemueller. Tijdschr. Sociale Geneesk., 40: 579-84(Oct. 5, 1962).

A survey of the experience gained in medical precautionary measures in Dutch reactor stations is presented. Radiation hazards and consequences, units of measurement, the standardization of the maximum permissible doses, the detectability and detection of atmospheric, and material and body contamination are discussed in detail. The value of excrement analyses by various methods, of leukocyte counts, and of the determination of double-nucleus lymphocytes during periodical medical examinations are also discussed along with internal safety measures, safety analyses, restriction of access to certain rooms, and air locks. (Occupational Safety Health Abstr., 2: No. 2, 1964)

9424 IONISING RADIATIONS (SEALED SOURCES) (LEAKAGE TEST) ORDER (NORTHERN IRELAND) 1963. "Statutory Rules and Orders of Northern Ireland," 1963, No. 13. Belfast, Ministry of Labour and National Insurance for Northern Ireland, 1963. 2p. 3d(HMSO, Belfast)

The test for leakage of radioactive substances to be made of sealed sources and the particulars to be contained in the registers of every such test, required under Regulation 15 of the Ionizing Radiations (Sealed Sources) Regulations (Northern Ireland), 1962 (CIS 1553-1963, Boq Shz (627)), are prescribed. This Order also prescribes for purposes of paragraph (4) of the said Regulation 15 the extent of leakage of radioactive substance from a sealed source beyond which the sealed source may not be brought into use until repairs have been effected. (Occupational Safety Health Abstr., 2: No. 1, 1964)

9425 GEFAHREN IONISIERENDER STRAHLEN. (Ionizing Radiation Hazards). E. Kaufmann. Lucerne, Switzerland, "Schweizerische Blätter für Arbeitssicherheit," Schweizerische Unfallversicherungsanstalt, 1963, No. 51. 20p.

A description is given of the applications of ionizing radiation and radioactive substances in industry from the point of view of the hazards facing employees who are called upon to handle radiation equipment and sources, including particle accelerators, and sealed and unsealed sources. Protective measures to be adopted in various fields (industrial radiography for the inspection of materials or the testing of products; elimination of static electricity; use of luminous compounds), and techniques for determining the radiation doses absorbed by the human body are included. (Occupational Safety Health Abstr., 2: No. 2, 1964)

9426 THE TRANSPORT OF RADIOACTIVE MATERIALS. INTERIM RECOMMENDATIONS FOR THE APPLICATION OF ENVIRONMENTAL TESTS TO THE APPROVAL OF PACKAGING. Risley, Warrington, Eng., United Kingdom Atomic Energy Authority, 1963. 117p. 9s.[(HMSO)].

Regulations made by the International Atomic Energy Agency for the safe transport of radioactive materials require the control of the four hazards peculiar to these materials by containment, shielding, criticality control, and heat transfer. The Regulations describe three main standards of packaging in terms of the environmental conditions under which the packaging must contribute to this hazard control. Transport environmental conditions (both normal and accident) are surveyed and corresponding environmental tests that may be used, when necessary, to demonstrate that packaging designs comply with the appropriate standards are proposed. (Occupational Safety Health Abstr., 2: No. 2, 1964)

9427 TRAINING IN RADIOLOGICAL PROTECTION: CURRICULA AND PROGRAMMING. (International Atomic Energy Agency, Vienna). Technical Reports Series No. 31. 1964. 110p. (STI/DOC/10/31). $2.50; Sch 52.50; 15s.stg; F.fr.10,-; DM 8,-(IAEA).

Training programs for radiological protection are discussed. Curricula are suggested and examples of established training courses are included. (C.H.)

9428 THE RELATIONSHIP BETWEEN SURFACE AND AIRBORNE CONTAMINATION. R. T. Brunskill (United Kingdom Atomic Energy Authority, [London]). 26p. (CONF-555-12)

From International Symposium on Surface Contamination, Gatlinburg, Tenn., June 1964.

A series of measurements correlating surface contamination of floors and clothing with resulting airborne contamination was made in selected areas of one of the production factories of the United Kingdom Atomic Energy Authority. Results indicated a strong correlation between the level of airborne activity and general movement of personnel in the area. It was found that, under the experimental conditions, a loose floor contamination of 1 unit/metre^2 gave rise to an airborne concentration of 4×10^{-3} units/metre^3 in a small unventilated room and to an airborne concentration of an order of magnitude less in a large well ventilated region. A mean surface contamination of 1 unit/metre^2 on clothing could cause airborne concentrations of $2-3 \times 10^{-3}$ units/metre^3. Personal air sampler results showed, however, that 1 unit/metre^2 of clothing contamination gave an average airborne concentration of 6×10^{-4} units/metre^3 when people moved around a small unventilated room. This latter figure is regarded as of more practical significance. (P.C.H.)

9429 INSURANCE ASPECTS OF RADIATION DAMAGE IN REACTOR STRUCTURES. F. W. Catudal (Travelers Insurance Co., Hartford). 18p. (CONF-512-12)

From American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964.

A brief history is given on the development of boiler codes and standards and the role played by the insurance industry and insurance company engineers in providing insurance coverage and inspection services on conventional boilers and pressure vessels. (P.C.H.)

9430 CONSIDERATIONS ON THE LEVELS OF SURFACE CONTAMINATION. M. Dousset, J. Hamard, and M. Penotet (Commissariat a l'Energie Atomique, Fontenay aux Roses, France). 10p. (CONF-555-13). (In French)

From International Symposium on Surface Contamination, Gatlinburg, Tenn., June 1964.

Consideration is given to the derivation of maximum permissible contamination levels from the maximum permissible concentrations in air of the different radioisotopes. This would afford limits that would vary with the toxicity of the radioactive contaminant. The application of very strict limits to slightly toxic radioisotopes that occurs when applying the usual method of two limits, one for α emitters the other for β and $\beta\gamma$ emitters, would thus be avoided. It was concluded that it is possible that conservative limits expressed in μC/cm^2 may thus be established by applying in the general case a factor of 10^6 to the MPC in air for occupational exposure (40 hr/week) expressed in μC/cm^3. Calculations show that at these levels, the surface contaminations with β and $\beta\gamma$ emitters, which are most frequently encountered, do not involve external exposure exceeding the maximum permissible doses. (P.C.H.)

9431 GUIDES, STANDARDS, AND REGULATIONS FROM THE FEDERAL RADIATION COUNCIL POINT OF VIEW. C. C. Palmiter and P. C. Tompkins (Federal Radiation Council, Washington, D. C.). 15p. (CONF-642-14)

From Health Physics Society, Cincinnati, June 1964.

The Federal Radiation Council, established in 1959, advises the President with respect to problems in which radiation is a factor and recommends to the President guidance for Federal agencies in their radiation protection programs. Criteria for the development of radiation protection guidance is discussed. Guidance for protective programs to reduce exposure from radioactive materials after they are in the environment must consider any health benefit associated with the available reduction in exposure and the over-all impact on the program. The decision to take a protective action program must consider such factors as: the resulting exposure if no action is taken; how much exposure can be reduced by taking the action; the difficulty of making the action effective; and possible risks to health, direct or indirect, that may be associated with the action itself. (P.C.H.)

9432 PHILOSOPHICAL INFLUENCES ON RADIATION PROTECTION STANDARDS, SYMPOSIUM ON GUIDES, STANDARDS, AND REGULATIONS. Lauriston S. Taylor (National Bureau of Standards, Washington, D. C.). 17p. (CONF-642-12)

From Health Physics Society, Cincinnati, June 1964.

Changes and influences leading to changes in the philosophical approach to the general problem of developing radiation protection standards are discussed. (P.C.H.)

9433 A PROGRESS REPORT ON RADIOLOGICAL HEALTH EDUCATION AND TRAINING. Samuel C. Ingraham, II (Dept. of Health, Education, and Welfare, Washington, D. C.). 31p. (CONF-642-15)

From Health Physics Society, Cincinnati, June 1964.

Training activities of the Division of Radiological Health are reported for the years between 1961 and the present. It is stated that nationwide needs for radiation health specialists, forecast in 1958, will be met in 1970. The contribution made by the Division in meeting this national requirement through its program of university grant awards is reviewed. Grant and fellowship criteria are given and other training activities of the Division are explained. Appendix items include the suggested core curriculum requirements for a university program and sample short-course agendas. (auth)

9434 RADIO-RELEASE METHODS FOR THE EVALUATION OF ATMOSPHERIC POLLUTION. H. H. Ross and W. S. Lyon (Oak Ridge National Lab., Tenn.). Vienna, International Atomic Energy Agency, 1964, Preprint SM-55/49, 11p. (CONF-641001-14)

From Symposium on Radiochemical Methods of Analysis, Salzburg, Austria.

A radio-release method for the determination of trace amounts of sulfur dioxide in the atmosphere was developed. The method is based on the release of radioiodine according to the reaction: $5SO_2 + 2K^{131}IO_3 + 4H_2O \rightarrow K_2SO_4 + 4H_2SO_4 + {}^{131}I_2$. The reaction is carried out in solution by pulling air through a bubbler train containing a basic potassium iodate solution. After the sample has been completely reacted, the solution is acidified. The liberated iodine is extracted into chloroform and is counted in a well-type scintillation detector. Using potassium iodate having an approximate specific activity of 2 mC/gram, a lower detection limit of 1.0 μmg of SO_2 was obtained. Thus, as little as 10^{-4} ppm of SO_2 can be determined in a 10-liter air sample. The method is linear to at least 1 mg of SO_2. (P.C.H.)

9435 IMPROVEMENTS IN OR RELATING TO CONTAINERS FOR TRANSPORTING RADIOACTIVE MATERIALS. Frank Edward Dixon (to United Kingdom Atomic Energy Authority). British Patent 973,448. Oct. 28, 1964. Filed Oct. 3, 1962.

A three-part container for transporting radioactive materials consists of an inner hermetically sealable vessel of dense radiation-resisting material, a thermal insulating casing for the vessel, and an outer cannister of fire-resisting material. The cannister may be held in spaced relationship within at least one further cannister so that the space shielding of the inner vessel is increased. Preferred materials include lead with a mild steel sheath for the inner vessel, hardwood for the insulating casing, and mild steel for the cannisters. Dimensions of the containers may be varied to provide shielding for up to 20,000 C of ^{60}Co. (A.G.W.)

INSTRUMENTATION

General

Refer also to abstracts 8851, 9558, 10163, and 10467.

9436 (AERE-M-1465) A SIMPLE METHOD FOR DETERMINING REFLECTED PULSES DUE TO IMPERFECT CABLE TERMINATIONS. M. O. Deighton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Dec. 1964. 9p. Dep.; $0.30(BIS); 1s. 9d. (HMSO).

A simple equivalent circuit is presented that simulates a mismatched cable termination. Using this, the output waveform resulting from an incident pulse or transient can be determined, usually by inspection, and the reflected signal then follows by subtraction of the incident one. Illustrative examples include simple cases, as well as one case in which multiple reflections occur at both ends of a cable. (auth)

9437 (BNL-8703) CONTINUOUS-RECORDING SPECTROPHOTOMETER. A. Olsen, S. Goscinski, D. Miller, and J. Palmer (Brookhaven National Lab., Upton, N. Y.). Apr. 16, 1962. Contract AT-30-2-GEN-16. 26p. Dep. (mn); $2.00(cy), 1(mn) OTS.

The operation of the portable spectrophotometer (a Beckman instrument modified for continuous registration of optical density) is described. The lambda power supply, power design power supply, mechanical chopper, amplifier and linear rectifier, and recorder are described. Block and circuit diagrams are included. (D.L.C.)

9438 (CEA-R-2481) LES COUPLES THERMOELECTRIQUES D'ALLIAGES TUNGSTENE–RHENIUM. (Thermoelectric Couples Made of Tungsten–Rhenium Alloys). F. Davoine, Robert Schley, and M. Villamayor (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Aug. 1964. 23p. Dep.(mn).

With a view to using tungsten–rhenium alloy junctions in nuclear reactors, a systematic preliminary study of these elements was made. For the combinations W/W–26 per cent Re and W–5 per cent Re/W–26 per cent Re, with or without sheath, the following properties were investigated: emf, reproducibility of measurements, and influence of thermal shocks. After a description of the method used, results are given showing the possibilities of these alloys for accurate temperature determinations up to 2300°C. (auth)

9439 (CEA-R-2551) PROJET DE DIVISEUR ANALOGIQUE PAR COMPTAGE ELECTRONIQUE. (Design of an Analog Divider Using Electronic Counting). Jacques Novat (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1964. 66p. Dep.(mn).

An apparatus is designed to give the reciprocal of a number between 10^3 and 10^7. In practice this number can be the pulse count provided during a given time by a detector of the BF_3 type during a criticality experiment. The apparatus is made up of two parts: one provides, by means of relays, a voltage proportional to the reciprocal required; and the other is a numeric voltmeter measuring this voltage between 0.1 and 1 volt. The relative error of the result is under 5 per cent. (auth)

9440 (CEA-R-2571) ETUDE D'UN DISPOSITIF POUR LA MESURE DIRECTE DE LA PRESSION DES GAZ DE FISSION A L'INTERIEUR D'UN ELEMENT COMBUSTIBLE EN PILE. (Study of a Device for the Direct Measurement of the Fission Gas Pressure Inside an In-Pile Fuel Element). Bernard Lavaud (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay) and Serge Uschanoff (Société Grenobloise d'Etude et d'Applications Hydrauliques, Grenoble, France). Aug. 1964. 18p. Dep.(mn).

The fission gas pressure inside a fuel element made of a refractory fuel constitutes an important limiting factor for the burn-up. It is very difficult to evaluate the pressure since the volume allotted to the fission gases, as well as their temperature, are known only very approximately. This physical value can only be known by direct in-pile measurement of the pressure. The report describes the equipment which has been developed for this test. (auth)

9441 (HW-66829) MULTICHANNEL ANALYZER STABILITY AND LINEARITY MEASUREMENTS. R. E. Connally (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 20, 1960. Contract AT(45-1)-1350. 10p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The zero drift, gain drift, and linearity of a number of multichannel pulse height analyzers were measured over extended periods of time. The measurements were made by use of a special pulse generator in order to study the characteristics of unattended operation of multichannel analyzers, in conjunction with automatic sample changers. (auth)

9442 (HW-83967) CREEP DATA LOGGER. L. L. Azure, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1964. Contract AT(45-1)-1350. 37p. Dep.(mn); $2.00(cy), 1(mn) OTS.

A hybrid data logger-controller is described which was developed for use in studies of in-reactor creep of structural materials. The logger-controller records on tape all the creep test data at the test facility and controls up to eight micropositioner mechanisms which perform creep measurements. The theory of operation and operating procedures are also given. (D.L.C.)

9443 (IPP-3/14) ZUM BAU VON DREHSPIEGELKAMERAS GROSSER LICHTSTARKE. (On the Construction of Rotary Reflection Cameras of Large Light Intensity). H. Muntenbruch (Institut für Plasmaphysik, G.m.b.H., Garching, Germany). Apr. 1963. 79p. Dep.(mn)

The various individual problems that play a role in the construction of rotary reflection cameras (vignetting effect, power needs, time resolution, spatial resolution, etc.) are described. A self-collimation camera that satisfies the requirements considered in the individual problems is described. (tr-auth)

9444 (KFK-247) NICHTINTEGRIERENDER VERLANGERER FUR IMPULSE VON 20 mV BIS 2,5 V HOHE UND 6 BIS 300 ns LANGE. (Non-Integrating Stretcher for Pulses of 20 mv to 2.5 v Height and 6 to 300 ns Length). Christian Weddigen and T. H. Karlsruhe (Kernforschungszentrum. Institut fur Experimentelle Kernphysik, Karlsruhe, Germany). Sept. 1964. 21p. Dep.(mn)

A fast non-integrating pulse stretcher with small dead time has been developed for 6 to 300 nsec and 0.02 to 2.5 v negative input pulses. During the rise time of the input pulse the quiescent current of an emitter follower with capacitive load is interrupted for 1 μs by a tunnel diode generator triggered by the input pulse. After this time, the quiescent current of the emitter follower discharges the load capacitor within less than 140 nsec. Thus at this capacitor one gets a 1-μs rectangular pulse with the same amplitude as that of the input pulse. Three outputs are available: positive and negative polarity adjustable up to ± 5.5 v maximum output pulse, and the 1.2 v negative generator pulse. Linearity for input pulses between 0.1 and 2.5 v is better than 2%. The temperature coefficient is less than 5×10^{-4}/°C. (auth)

9445 (LA-3130) A PULSED HIGH-ENERGY RADIOGRAPHIC MACHINE EMITTING X RAYS. I. THE RADIATION PROBLEM. Douglas Venable (Los Alamos Scientific Lab., N. Mex.). Nov. 9, 1960. Contract W-7405-eng-36. 347p. Dep.; $7.00(OTS).

In planning flash radiographic experiments to facilitate the study of explosives and explosive-driven metal systems which demand penetration of thick sections, it is necessary to know the optimum radiation spectrum for the material being radiographed, how to generate this spectrum with the required flux, and the transmission characteristics of various spectra when penetrating experimental assemblies. The information needed to provide estimates of answers to these problems is presented. This includes a survey of bremsstrahlung production as a function of both electron energy and target material, the intensity-angle distribution of the useful radiation, and the transmission and spectral degradation of bremsstrahlung through materials which are possible candidates for experimental systems. The most important parameter in this study is the electron energy which was varied from 5 to 100 Mev. Target materials ranged from beryllium to uranium, with tungsten chosen as most suitable because of its refractory properties and its high bremsstrahlung production efficiency. (auth)

9446 (NP-14604) NUCLEAR TESTING CORRELATED AND APPLIED TO COMPACTION CONTROL IN COLORADO. Wayne R. Brown (Colorado Dept. of Highways, Denver). [nd]. 42p.

A study was made to correlate results obtained with the Nuclear-Chicago d/M gage with the standard methods of determining density and moisture content in the field. The operation of the gage is described, and its advantages are outlined. (D.L.C.)

9447 (NP-14610) FIELD EVALUATION OF NUCLEAR GAGES USED IN COMPACTION CONTROL OF EMBANKMENTS. Valentin Worona and William G. Gunderman (Pennsylvania Dept. of Highways. Bureau of Materials and Testing and Research, Harrisburg). 1963. 63p.

A study was made to determine the feasibility of using nuclear moisture-density d/M gages made by Nuclear Chicago Corp. to control material compaction in highway construction. Eleven gages were used in the field in Pennsylvania's engineering districts, and the results were compared to the sand-cone method for determining soil density and the oven drying and speedy moisture methods of determining moisture content. (D.L.C.)

9448 (NYO-3421-2) PHOTOMULTIPLIER INVESTIGATION. Second Quarterly Report, October 15, 1964–December 15, 1964. H. M. Smith, Jr., and R. Wasserman (Radio Corp. of America. RCA Labs., Princeton, N. J.). Jan. 7, 1964. Contract AT(30-1)-3421. 24p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Two problems often encountered by users of photomultiplier tubes today are those of dark pulses and gain shift with count rate or short-term stability. Investigations are currently in progress on the causes of these problems and the results to date are presented. With regard to the dark current problem, many tubes were studied and some of their similarities and differences are analyzed. All tubes examined appear to exhibit three types of dark pulses, namely, thermionic electron pulses, non-thermionic "single" electron pulses, and non-thermionic "multi-electron" pulses. Tentatively, the observations appear to indicate that the rate of occurrence of the latter type depends primarily on the field in the vicinity of the cathode and their size at the anode upon the multiplier gain divided by the first dynode gain. The effects of voltage distributions and temperature on these dark pulses are discussed in some detail. (auth)

9449 (PPAD-507-E) PRECISION VARIABLE DELAY LINE AND SPLITTER. J. Kirchgessner and J. Riedel (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Dec. 9, 1963. Contract AT(30-1)-2137. 11p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A variable delay line has been developed with a continuously variable delay range of 6 to 60 nsec. The rise time is better than one nsec at 60 nsec delay and the delay can be directly read to 0.05 nsec accuracy. The unit may also be used as a splitter in which case the sum of the absolute delay of the two outputs is a constant 60 nsec. The device has a Z_0 equal to 50 ohms and the two outputs are each equal in amplitude to one half the amplitude of the input pulse. (auth)

9450 (UCRL-11218(Pt.I)) THE DESIGN, CONSTRUCTION, AND OPERATION OF A DIFFERENTIAL MICROMANOMETER. PART I. ELECTRONICS. Kenneth W. Lamers (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 16, 1964. Contract W-7405-eng-48. 31p. Dep.; $2.00(OTS).

A description is given of the electronics of a micromanometer designed to measure pressure differentials on the order of 0.1 micron with an accuracy of 3%. The micromanometer is to be used in conjunction with a Wrede gage, a device that converts atomic concentration into a pressure differential. The pressure difference is sensed by a membrane manometer constructed in the form of a differential capacitor that forms two legs of a resonant-bridge network excited by a radio-frequency source. The bridge output (2.7 Mc) is amplified and fed to a phase-sensitive detector that determines the direction of unbalance and develops a dc voltage that restores the membrane essentially to its initial position. The restoring voltage is directly proportional to pressure differential and is indicated by a recorder. Details of frequency considerations and selection of parameters that lead to increased bridge sensitivity are discussed. (auth)

9451 (UCRL-13134) DEVELOPMENT AND MANUFACTURE OF A 2-Mv FLASH X-RAY SYSTEM AND RADIOGRAPHIC TUBE. Final Report, October 1, 1962–September 30, 1964. John L. Brewster, Richard E. Anderson, Colin G. Powers, Kenneth E. Smith, and Francis M. Charbonnier (Field Emission Corp., McMinnville, Ore.). Contract [W-7405-eng-48], Subcontract 211. 50p. Dep. (mn); $2.00(cy), 2(mn) OTS.

A 2-Mv radiographic flash x-ray system was developed and is presently providing diagnostic information previously not obtainable either from 600 kv flash x-ray equipment or higher voltage pulsed Linacs. In addition to the tube voltage and energy sufficient to provide useful penetration and contrast, the extremely short duration (approximately 75 nanoseconds) of the flash x-ray beam permits "stop-motion" radiography of extremely high velocity events. The equipment was furthermore designed for maximum convenience and reliability, expected under field test conditions, consonant with the design standards of Field Emission Corporation's commercial flash radiographic apparatus. The system had a good x-ray yield and stable operation at 1.5 Mv, and some encouraging operating experience was obtained at 2 Mv. (D.L.C.)

9452 (USAELRDL-TR-2456) PRESSURE CALIBRATION OF THE GOETZ AEROSOL SPECTROMETER. Hermann E. Gerber (Army Electronics Research and Development Lab., Fort Monmouth, N. J.). Apr. 1964. 30p. (AD-602142)

The pressure dependence of the operating characteristics of the Goetz Aerosol Spectrometer is discussed and determined. Since the fallout of particles in the Goetz centrifuge depends on the mean free paths of the air molecules, the deposition characteristics of the aerosol particles (according to the Cunningham correction to the Stokes Law) become a function of air density or pressure. Calibration runs were conducted with monodisperse latex particles of various sizes in a pressure chamber simulating various atmospheric altitudes. The deposition lengths for aerosol particles of a given size decrease with decreasing pressure. The smaller the aerosol particles, the greater is the pressure dependence on the particle deposition. Correction factors could be determined for various particle sizes in atmospheric pressure. Some examples of application of these pressure calibrations to field measurements, conducted at Flagstaff, Arizona, area during July and August 1963, are presented. (auth)

9453 (UCRL-Trans-1169(L)) REPORTS AT THE THIRD CONFERENCE ON PHYSICS OF PLASMA AND THE PROBLEM OF CONTROLLED THERMONUCLEAR REACTIONS. IONIZATION MANOMETER WITH COLD CATH-

ODE. B. A. Sharevskii and G. T. Nikolaev (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut, Karkov). Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore). 1963. 16p. Dep.(mn); \$1.00(cy) 1(mr) OTS; \$1.60(fs), \$0.80(mf) JCL.

A small-scale, compact ionization manometer with cold cathode is described, for which at specific values of V and H linearity was achieved between the ion current and the pressure, starting with 10^{-4} mm Hg, right down to the lowest achieved pressures in the device, 4 to 5×10^{-9} mm Hg. The sensitivity of the manometer is ten times greater than that of tubes with hot cathode, thus reducing the effect of different kinds of backgrounds in measurements and offering a possibility of measuring pressures right down to 1×10^{-9} mm Hg with the ordinary microammeter of the type M-95. The availability of several stable regimes of operation makes the device more flexible in experiments and offers the possibility of reliably controlling the pressure in the system. (auth)

9454 HIGH-FREQUENCY ION SOURCE WITH AUTOFOCUSING. A. V. Almazov and F. F. Myntsov. Pribory i Tekhn. Eksperim., No. 5, 43-5(Sept.-Oct. 1964). (In Russian)

The design and performance of a modified ion source with high-frequency fields excited in a retort by two rings fitted at cylindrical sections with simultaneously applied constant longitudinal magnetic fields are discussed. It is shown that the source may be efficiently used for producing ions of helium and hydrogen isotopes. The autofocusing system of ion beams in a 4 mv electrostatic generator improves generator performance. (R.V.J.)

9455 CALORIMETRIC MEASUREMENTS OF THE BEAM INTENSITY OF PULSED ION SOURCE. A. S. Knyazyatov, V. V. Maltsev, and G. A. Otroshchenko. Pribory i Tekhn. Eksperim., No. 5, 46-8(Sept.-Oct. 1964). (In Russian)

Calorimetric measurements were made of ion source current with ~1 μsec pulse duration and ~10 ma current at ~100 kev ion energy and 15 sec repetition time. Descriptions are given of the current recorder constructed using a manometer LT-2 tube. Calorimetric measurements proved efficient for measurements made in a low vacuum chamber (10^{-4} to 10^{-6} torr) where electric measurements of ion current are very complex. (tr-auth)

9456 CRYOGENIC NANOSECOND PULSE RECIRCULATOR. A. J. Cummings and A. R. Wilson (Edgerton, Germeshausen & Grier, Inc., Las Vegas, Nev.). Proc. IEEE (Inst. Elec. Electron. Engrs.), 52: 1749(Dec. 1964).

Pulses with subnanosecond rise times and nanosecond widths were circulated in cryogenic superconducting delay lines with lengths from several hundred nanoseconds to several microseconds. Two recirculators were used—the first, a delay line shorted at both ends, and the second, a loop closed on itself. (M.J.T.)

9457 HIGH EFFICIENCY SOURCE FOR METAL IONS. G. D. Magnuson, C. E. Carlston, P. Mahadevan, and A. R. Comeaux (General Dynamics/Astronautics, San Diego, Calif.). Rev. Sci. Instr., 36: 136-42(Feb. 1965).

An ion source is described which produces beams of both high and low vapor pressure materials. The source has the following characteristics which make it suitable for accelerator applications or laboratory ion beam experiments where the large size and complexity of isotope separator ion sources would be a disadvantage: small size, simplicity of construction and operation, long filament life, high charge utilization efficiency, wide operating temperature range, relatively modest power requirement, ability to operate efficiently on either gas or solids. The source operates by electron bombardment ionization of the vapor of the charge material. The vapor is obtained by heating the charge to a sufficiently high temperature to achieve the proper source operating pressure. A unique feature of this source is the combination of the discharge chamber and charge container into one chamber. The operating temperature range of the source is from approximately 300 to about 1600°C. Beams of Zn^+, Al^+, Cu^+, Ag^+, Au^+, and Fe^+ ions were produced which contain but a small percentage of impurity ions. The charge material in all these cases was the pure metal. (auth)

9458 TWO ELECTRICAL CONTACTOR PIN DESIGNS. Richard D. Dick and Thomas E. Gould (Los Alamos Scientific Lab., N. Mex.). Rev. Sci. Instr., 36: 143-5(Feb. 1965). (LA-DC-6564)

Simple designs for a coaxial electric contactor pin and an insulated single conductor pin for measuring shock velocities are described. The coaxial pin consists of a hypodermic tube for the outer conductor with an insulated wire inside which is setback one mil. A formed silver foil cap covers the recessed end. The single conductor pin has a Mylar film over one end and insulated tubing covering the length. Both types of pins have performed satisfactorily over a wide pressure range at ambient and liquid nitrogen temperatures. (auth)

9459 PULSE PATTERN GENERATOR FOR TRANSIENT NMR EXPERIMENTS. A. G. Favret and R. Meister (Catholic Univ. of America, Washington, D. C.). Rev. Sci. Instr., 36: 154-7(Feb. 1965).

A pulse pattern generator for transient NMR experiments was built using commercially available solid state circuit modules. The generator provides stable pulse widths and delays from a few microseconds to several seconds. By replacing a single blank module the logic can be changed from a Carr-Purcell T_2 sequence to a T_1 sequence of pulse pairs with systematically increasing delay between pulses. The 90 and 180° pulse widths are accurately preserved in the change over. A variety of gating pulses are available to synchronize oscilloscopes or to activate circuits for suppressing the ring following a transmitted pulse. (auth)

9460 IMPROVED NMR PROBE FOR MAGNETIC FIELD MEASUREMENTS. W. L. Pierce and J. C. Hicks (Oregon State Univ., Corvallis). Rev. Sci. Instr., 36: 202-3(Feb. 1965).

A small, simple, transistorized, marginal-oscillator type nuclear magnetic resonance (NMR) spectrometer was developed for high resolution mapping fields in relatively inaccessible locations, such as the interior of superconducting solenoids. With a probe volume of 8×10^{-6} liter, the device is able to give magnetic flux-density measurements to an accuracy of 2 parts in 10^6 with a spatial resolution of about 1 mm. Remote operation of all controls adds considerably to its versatility. (auth)

9461 DEW-POINT HYGROMETRY BELOW 0°C BY THE USE OF A RADIOACTIVE α SOURCE. Hisanobu Kobayashi. Sci. Papers Inst. Phys. Chem. Res. (Tokyo), 58: 106-10(Sept. 1964).

Work on hygrometry based on the principle that the absorption of α particles by deposited dew weakens the ionization current. Below 0°C, the temperature of the dew-depositing surface, at which the ionization current undergoes a rapid decrease, decides the dew-point of water saturation. Microphotographs show that down to about −40°C, water vapor begins to condense as supercooled water. The difficulty met with the mirror type hygrometer below 0°C in judging whether the deposition is dew in the form of supercooled water or ice is removed in this method. (auth)

9462 A NEW X-RAY CAMERA BASED ON THE GUINER PRINCIPLE. Richard Schrader and Gottfried Tetzner (Institut für Anorganische and Analytische Chemie der Bergakademie, Freiburg i. B.). Z. Anorg. Allgem. Chem., 323: 137-48(July 1963). (In German)

A simultaneous photograph of all possible diffraction rays that can be focused is ensured by a combination of the Seeman-Bohlin procedure and a monochromator used in the Guiner procedure. To eliminate transverse incidence of deflected rays onto the film they are affixed onto the chamber walls, placed so that each incident diffracted ray impinges on a specific strip of film. The film section is so placed that the diffraction rays impinge perpendicularly, resulting in complete focussing. Since there is no diffusion of the interference pattern produced by rays that impinge obliquely the lines can be evaluated for particle size and lattice distortion without additional corrections. The cylindrical chamber wall used in the Guiner chamber has been replaced by a guide ring, on which the film retainers are arranged along the focal orbit, where their positions can be adjusted to the angle of incidence of the impingent diffraction rays. The film holders are constructed so that the median line of the film strips comes to lie at the intersection point of the reflected ray and the focussing ring, perpendicular to the focal plane. Positioning of the film perpendicular to the diffraction ray is made possible by the rotatability of the film strips about the medial line. With the new chamber it is possible to obtain symmetrical and asymmetrical images by penetrating and reflective procedures. When tested with prepared metal powders particle size determinations showed good agreement with values obtained from the Guiner camera. Differences were related to transverse incidence. A formula was developed for correction of particle size measurements made by a Guiner camera. The advantages of the newly developed camera were demonstrated and emphasized by geometrical and mathematical considerations. (BBB)

9463 PHOTOGRAPHIC EMULSIONS AS ION DETECTORS IN QUANTITATIVE MASS SPECTROGRAPHY. Edward B. Owens (Massachusetts Inst. of Tech., Lexington). 14p. (CONF-649-22)

From 12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964.

A review is presented of the factors involved in the quantitative detection of ions using photographic emulsions. The nature of the ion interaction with the silver halide crystals and gelatin binder, the sensitivity and sensitization of plates, and the measurement of emulsion darkening, or the Reciprocity Law, are discussed. Factors involved in the choice of emulsion, emulsion processing and calibration, and analytical accuracy in the measurements are reviewed. (H.D.R.)

9464 RADIO-FREQUENCY ABSORPTION EXPERIMENTS IN THE OMEGATRON. P. M. Llewellyn and D. P. Littlejohn (Varian Associates, Palo Alto, Calif.). 5p. (CONF-649-16)

From 12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964.

The omegatron, a mass spectrometer which measures the mass of an ion by the periodic nature of its motion in a magnetic field, is described and used to investigate the mass spectrum of toluene and bromoform. (H.D.R.)

9465 SOME RECENT IMPROVEMENTS IN ELECTRON BEAM SYSTEMS. O. Winkler (Balzers Aktiengesellschaft, Liechtenstein, Ger.) and G. F. Barber. 29p. (CONF-603-8)

From Transaction of Meeting, Vacuum Metallurgy, American Vacuum Society, New York, June-July 1964.

Described are some refinements in electron beam gun systems which were made primarily for the purpose of increasing the stability of operation, as a function of operating time. The quality of the processed parts, as determined by the heat patterns generated by the beam, and the ease of maintenance, convenience of operation, and overall process efficiency, as dictated by the ingenuity of design and the careful attention to small but important details, are also considered. (auth)

9466 ANALYZER SENSITIVITY PARAMETERS IN A DOUBLE-FOCUSING MASS SPECTROGRAPH. Charles W. Hull (Consolidated Electrodynamics Corp., Pasadena, Calif.). 17p. (CONF-649-18)

From 12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964.

The Mattauch-Herzog-Robinson geometry is considered in a study of the relation between sensitivity and resolution in a double-focusing mass spectrograph. The aberrations are presented in terms of the instrument slits and stops and the beam width function is derived. The optimum instrument transmission for a given beam width is derived, and the resolution-sensitivity relation is shown. Sensitivity is discussed as it relates to accelerating voltage and scattered background. (H.D.R.)

9467 GAMMA DENSOMETER. James Joseph Wright (to Cleveland Technical Center Inc.). British Patent 973,708. Oct. 28, 1964. Filed Apr. 24, 1962.

An apparatus is described for rapidly and dependably testing the density of railway sleepers to determine their structural soundness by the use of gamma rays without cutting or otherwise damaging the sleepers. A vehicle adapted to travel along the track carries means for emitting gamma radiation into each sleeper being tested, means for detecting the gamma radiation scattered from the interior of each sleeper, and means for translating the response of the detector to indicate the density of the sleeper. The Compton scattering of gamma rays is utilized to determine the density and hence the soundness of the wood. The preferred source of radiation is 200 μC of ^{137}Ce. A typical scintillation crystal mounted in the conventional manner on a photo-multiplier tube is employed as a detector. (A.G.W.)

9468 GAMMA DENSOMETER. James Joseph Wright (to Cleveland Technical Center Inc.). British Patent 973,709. Oct. 28, 1964. Filed Apr. 24, 1962.

A method and apparatus are described for the rapid and dependable determination of the structural soundness of bodies permeable to gamma radiation by testing the density of such bodies by the use of gamma rays without cutting or otherwise damaging the bodies. A radiation source for emitting incident gamma radiation of energy less than about 1.02 Mev and a radiation detector for detecting gamma radiation scattered from the interior of the body are both placed outside the body. The detector and source are placed in such a manner that the detector detects scattered gamma radiation falling in a cone having a semi-angle of substantially 30° and its axis along the direction of incident radiation. This method is applicable particularly to the testing of railroad sleepers to determine the soundness of their internal structures. (A.G.W.)

9469 GAMMA RAY THICKNESS GAGES. J. L. Putman, S. Jefferson, and R. B. Owen (to U. S. Atomic Energy Commission). U. S. Patent 3,076,894. Feb. 5, 1963.

A gage for measuring thickness of metals using a gamma ray source and detector is described. The gamma back-scattering principle is used eliminating the need for a shield between the gamma source and the detector by including a pulse amplitude discriminator in a detector to distinguish between back-scattered rays from the metal and the direct rays from the source. (AEC)

9470 MASS FLOW MEASURING DEVICE. Glenn M. Burgwald, Leonard Reiffel, William Genthe, and Clinton Fyfe (to U. S. Atomic Energy Commission). U. S. Patent 3,164,019. Jan. 5, 1965.

A device is described for providing a measure of the square of the mass flow rate divided by the density of a fluid flowing in a pipe. The device comprises a tube having two end portions and a central portion lying in one plane, the central portion of the tube being offset from the two end portions. Means are provided for elastically coupling the tube to the pipe. A pivot is connected to the central portion of the tube with the pivot being rotatable with the tube in the plane thereof responsive to fluid flow through the tube. Means are provided for applying restoring torque to the pivot to cause the tube to remain in a null position and means are also provided for measuring the applied restoring torque, which torque is proportional to the square of the mass flow rate divided by the density of the fluid flowing in the pipe. (AEC)

9471 ION PULSE GENERATOR COMPRISING DEFLECTOR MEANS TO SWEEP A BEAM ACROSS AN APERTURED MEMBER. R. F. King (to U. S. Atomic

Energy Commission). U. S. Patent 3,164,718. Jan. 5, 1965.

An ion beam pulser is described for generating periodic short-duration bursts of ions and at the same time eliminate undesired masses from the pulsed ion beam. A first source of high frequency is connected to a first lower set of deflection plates in the pulser, a second source of high frequency of some multiple of the first frequency is connected to a second upper set of deflection plates displaced 90° from the first set, and a lateral d−c shifting voltage is also connected to the first set of deflecting plates to achieve mass differentiation of the ion masses in the ion beam fed to the beam pulser. Separate Lissajous-type beam sweeps are produced in the beam pulser and, with proper phase relationship between the sweep voltages and with the proper shift of the beam sweeps with the d−c voltage, a selected mass of ions can be withdrawn from the beam pulser once each cycle. (AEC)

Radiation Detection

Refer also to abstracts 9053, 9059, 9173, 9357, 9404, 9773, 9867, 10186, and 10335.

9472 (AD-602717) LIQUID SCINTILLATION COUNTING APPLIED TO RADIOMETRIC TOOL WEAR TESTING. W. Dennis McHenry (Rock Island Arsenal Lab., Ill.). Mar. 4, 1964. 21p. $0.75 (OTS).

Liquid scintillation techniques are shown to be approximately 20 times more sensitive than solid crystal techniques for the determination of beta activity in metal chips cut with an irradiated tool bit. Relative tool wear can be determined easily by simply immersing the metal chips in a suitable counting solution. Total wear can be determined accurately by extracting the radioactive tracer from the chips and comparing it with the specific activity of the tool bit. (auth)

9473 (AE-162) A NEEDLE-TYPE p-i-n JUNCTION SEMICONDUCTOR DETECTOR FOR *IN-VIVO* MEASUREMENT OF BETA TRACER ACTIVITY. A. Lauber and B. Rosencrantz (Aktiebolaget Atomenergi, Stockholm). 1964. 18p. Dep.(mn).

A miniature detector probe was developed for *in vivo* detection of beta tracer activity. A lithium-drifted p-i-n semiconductor detector shaped as a cylinder 0.9 mm in diameter and 3 mm long acts as the sensing element. The detector is encased in a stainless steel tube 50 mm long, fastened to a holder fitted with a miniature coaxial contact. The free end of the tube has a syringe-like, entirely tight tip. The steel tube has an outer diameter of 1.4 mm except for 10 mm at the free end where the outer diameter is 1.1 mm corresponding to a wall thickness of 0.05 mm. The detector is placed in the 1.1 mm part of the tube. The construction and the properties of the probe are described. (auth)

9474 (ANL-6903) A FORTRAN PROGRAM TO ANALYZE MASS SPECTROMETER ION OPTICS. Kurt Kaiser (Argonne National Lab., Ill.). Aug. 1964. Contract W-31-109-eng-38. 24p. Dep.; $1.00(OTS).

A FORTRAN program is described for the computation of ion-optical aberration coefficients through second order for any number of tandem electric and magnetic sector fields, such as those used in multistaged mass spectrometers. Also computed are the image positions and their magnifications, the system mass dispersion, and the inclinations of the direction- and energy-focusing planes with respect to the optic axis. (auth)

9475 (CEA-R-2451) BOUCLE A GAZ MESURE CONTINUE DE FLUX DE NEUTRONS THERMIQUES ET RAPIDES. (Gas Loop [for] Continuous Measurement of Thermal and Fast Neutron Fluxes). Yves Droulers, Gaetan Pleyber, Paul Sciers, and Guy Maurin (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Grenoble). Aug. 1964. 12p. Dep.(mn).

A measurement method is described that can be applied both to thermal and fast neutron fluxes. A description is given of two practical applications in each of these two domains. This method is particularly suitable for measurements carried out on "loop" type equipment. The measurement of the relative flux variations are carried out with an accuracy of 5 per cent. The choice of the shape of the gas circuit leaves a considerable amount of liberty for the adaptation of the measurement circuit to the experimental conditions. (auth)

9476 (CONF-640702-3) ELIMINATION OF THE COMPTON COMPONENT IN AMORPHOUS SCATTERING. B. E. Warren and G. Mavel (Massachusetts Inst. of Tech., Cambridge). [nd]. Contract AT(30-1)-905. 7p. Dep.(mn); $1.00(cy), 1(mn) OTS.

From American Crystallographic Assn. Annual Meeting, Bozeman, Mont.

Experimental elimination of the Compton component in amorphous scattering has been obtained by using crystal-monochromated Rh Ka radiation ($\lambda = 0.615$Å). The scattered radiation from the sample falls upon a sheet of Mo ($\lambda_K = 0.620$ Å). The fluorescence radiation, which is received in a Kr-filled counter placed near the Mo, is a close measure of the unmodified scattering since most of the modified scattering cannot excite fluorescence. The counter reading is high enough for direct chart recording. (auth)

9477 (CONF-650302-1) A POCKET DOSIMETER FOR CRITICALITY ACCIDENTS. W. C. Reinig, C. N. Wright, and J. E. Hoy (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). Dec. 1964. Contract AT(07-2)-1. 16p. Dep.(mn); $1.00(cy), 1(mn) OTS.

From IAEA Symposium on Personnel Dosimetry for Accidental High-Level Exposure to External and Internal Radiation, Vienna.

A pocket dosimeter is described which uses In, Cu, and S activation materials to measure the neutron dose over five energy intervals in the fission neutron spectrum. Gamma dosimetry is accomplished using thermoluminescent LiF. Tests of the dosimeter are described. (D.L.C.)

9478 (HW-83868) MINIATURE SIGNALING RADIATION DOSEMETER. D. P. Brown (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 1964. Contract AT(45-1)-1350. 21p. Dep.; $1.00 (OTS).

A miniature, pocket-size dosemeter was developed to provide an audible signal at the accumulation of a preselected dose by the incorporated sensor (a standard pencil-type ionization chamber). The chamber was modified for automatic recharging. The dosemeter audible alarm is energized within ±10% of the preselected signaling set point, typically 100 mR, under dose rate conditions up to 3.6 R/hr. For dose rates of 6 R/hr and greater, the deviation limits are ±25%. The solid state circuitry is powered by a single 1.35 v mercury battery that provides operation for about 1000 hr. A precharged capacitor provides voltage for the ion chamber. (auth)

9479 (HW-SA-3773) RADIATION QUANTITIES AND UNITS. W. C. Roesch (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 10, 1964. Contract AT(45-1)-1350. 9p. (CONF-641202-1). Dep.(mn); $1.00(cy), 1(mn) OTS.

From Annual Meeting of the American Association of Physicists in Medicine, Chicago.

Radiation quantities and units used in the dosimetry of high-energy radiation are discussed. The use of ionization chambers for measurements of high-energy γ and x radiation is discussed. (C.H.)

9480 (JINR-P-1899) SPEKTROMETR PO VREMENI PROLETA S FIL'TROM PERED DETEKTOROM. (A Time-of-Flight Spectrometer with a Filter in Front of the Detector). A. Baiorek, T. A. Machekhina, K. Parlin'ski, and F. L. Shapiro (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1964. 15p. Dep.(mn).

The described spectrometer, with a filter in front of the detector, is meant for measuring the energy and angular distributions of thermal neutrons scattered by solids, liquids, and gases. The spectrometer is designed to operate with a pulsed fast neutron reactor. After passing through the Be filter placed in the immediate vicinity of the sample, the neutrons scattered by the sample are detected. As a detector a scintillation counter is used. The energy of the neutrons incident on the sample is analyzed by the time of flight from the filter to the detector, and the neutron energy after scattering is determined by the filter transmission. A calculation of the instrumentation resolution is given as a function of its different parameters. The spectrometer allows a simultaneous analysis over the whole spectrum of the scattered neutrons in the angle interval from 20 up to 120°. The intensity obtained is given as well as the signal-noise ratio. (auth)

9481 (JINR-P-1909) PRIMENENIE METODA VREMENI PROLETA K NEITRONNO-DIFRAKTSIONNYM ISSLEDOVANIYAM. (Application of Time-of-Flight Method to Neutron-Diffraction Investigations). I. Sosnovska, E. Sosnovski, S. V. Kiselev, and R. P. Ozerov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1964. 5p. Dep.(mn).

The possibilities of the time-of-flight method if applied to neutron-diffraction investigations at a pulsed fast reactor (IBR) are discussed. The use of this technique to investigate the crystal structure of the badly studied compound $BeFeO_3$ is described. It is confirmed that there exists magnetic and atomic superstructure in the $BiFeO_3$ lattice. It is shown that the magnetic moments below Neel's point are oriented parallel to the (111) axis. (auth)

9482 (NASA-TN-D-2549) FINITE GEOMETRY CORRECTIONS TO GAMMA-RAY ANGULAR CORRELATION MEASUREMENTS. Jag J. Singh and Chris Gross (National Aeronautics and Space Administration. Langley Research Center, Langley Field, Va.). Jan. 1965. 39p. $2.00(OTS).

Large cylindrical sodium iodide crystals are used extensively in gamma angular correlation measurements. The finite angular resolution of these crystals affects the observed distribution of the gamma radiation. Consequently, the measured distribution function has to be corrected for finite geometry effects before the results can be compared with the theory. The correction factors depend upon the geometry of the counters and the absorption properties of the counter material. For detectors with axial symmetry, the effects of finite solid angle are to reduce the anisotropy without changing the form of the distribution function. These reduction factors have been calculated for gamma energies from 100 kev to 15 Mev. The cylindrical sodium iodide crystals considered include all regular sizes from 1.0 by 0.5 inch up to 5.0 by 5.0 inches, and the distance between the target and the sodium iodide crystal varies from 5.0 to 35 centimeters. The results are tabulated in the form of attenuation factors representing the fractional decreases in the coefficients of the true angular distribution function. When the entire area under the gamma-ray pulse is considered at each angle, these tables are accurate throughout the range of energies of gamma rays considered. For triple correlation between cascading gamma rays, the reduction factors which must be incorporated in the theoretical function will be given by the products of reduction factors for individual detectors. (auth)

9483 (NP-14419) USTANOVKA DLYA ABSOLYUTNYKH IZMERENII V RENTGENAKH RENTGENOVSKOGO IZLUCHENNYA OT 20 DO 60 KV. (A Device for Absolute Measurements of X-radiation from 20 to 60 kv). M. P. Avotina and G. P. Ostromukhova (U.S.S.R.). [1959]. 7p. Dep.(mn).

A design is given of plane-parallel ionization chamber installation for absolute measurements of x-radiation of 20 to 60 kev with the order of error ±1.5%. (R.V.J.)

9484 (NP-14473) REALISATION DE DETECTEURS A JONCTION DE GRANDE EPAISSEUR PAR LE PROCEDE DE LA MIGRATION DES IONS Li^+ (ION DRIFT) (these). (Utilization of Junction Detectors of Great Thickness by the Method of Migration of Li^+ Ions (Ion Drift) (thesis)). Gaston Bruge (Paris. Universite). Aug. 2, 1963. 58p. Dep.(mn).

The development of junction detectors capable of detecting heavy ions of average energy produced by the Saclay cyclotron was investigated. The theory of semiconductor detectors and a simplified theory of the processes of ion migrations were summarized. The different methods available for the fabrication of semiconductor detectors and their testing were reviewed. Impurities were important in the fabrication of this type of detector as the impurities delay the thermal diffusion and migration of Li. Impurities trap temporarily and definitively the charges produced by the passage of a charged particle, affecting the amplitude and rise time of the pulses. It was concluded that the impurity content in the initial materials was an essential factor in the successful fabrication of this type of junction. The conditions of cleaning, thermal diffusion, and development of contacts were also of great importance. (J.S.R.)

9485 (NP-14488) ETUDE D'UN SCINTILLATEUR GAZEUX POUR LA DETECTION DES PROCESSUS DE FISSION. (Study of a Gaseous Scintillator for Detection of Fission Processes). Claude Samour (France. Centre National de la Recherche Scientifique, Paris). [1963]. 100p. Dep.(mn).

Thesis submitted to Université, Paris.

A detector that can be used for the relative measurement of the cross section for the neutron fission of ^{239}Pu was studied. A general review was given of the processes inherent in the slowing down of a heavy charged particle. The scintillations of rare gases excited by nuclear particles were considered with a presentation of the principal results. The roles of the different processes described were examined and the basic characteristics of scintillating gas detectors were described. The design and characteristics of the rare-gas scintillator detector developed and the results obtained were reported. (J.S.R.)

9486 (NP-14495) REALISATION D'UN SPECTROMETRE MAGNETIQUE A HODOSCOPE (theses). (Development of a Magnetic Spectrometer with a Hodoscope (thesis)). Daniel Tinturier (Caen, France. Université). Mar. 13, 1963. 50p. Dep.(mn).

The development of a magnetic spectrometer with hodoscope for the study of cosmic radiation in the iron mine at May-sur-Orne was described. The various factors to be considered in the realization of such a device (pulse and energy, principle of magnetic deviation, determination of the radius of curvature, weak deviations, frequency of coincidences, fortuitous coincidences, determination of the length of the magnetic field, minimum frequency and minimum power of resolution, and errors) were analyzed. The design and construction of the magnetic spectrometer were then described. (J.S.R.)

9487 (OCD-2131-F) DIGITAL DISPLAY AERIAL SURVEY METER. Final Report. (Weston Instruments, Inc., Newark, N. J.). [1964]. Contract OCD-PF-64-10. 50p. (AD-602462). $2.00(OTS).

Three Digital Display Indicators have been incorporated into the CD V-781 Aerial Survey Meter replacing the three conventional panel meters to display dose rate readings numerically. The Digital Display Indicator contains a D'Arsonval mechanism and an optical system so arranged to provide a projected image on a screen. Readability error is virtually eliminated since only one indicator is visible at a time displaying a discrete reading of dose rate. Each Digital Display Indicator provides 10 distinct values in a two figure display measuring 3/4 inch high by 1/4 inch wide. (auth)

9488 (PPAD-529-E) PREPARATION AND PERFORMANCE OF A HOMOGENEOUS SILICON MINIMUM-IONIZING PARTICLE DETECTOR. H. Blumenfeld and F. P. Pandolfi (Princeton-Pennsylvania Accelerator, Princeton, N. J.). Oct. 29, 1964. Contract AT(30-1)-2137. 14p. (CONF-799-11). Dep.(mn); $1.00(cy), 1(mn) OTS.

From 11th Annual Nuclear Science Symposium, Philadelphia, Oct. 1964.

A homogeneous high-resistivity silicon crystal detector was developed for minimum-ionizing particles in a hydrogen bubble chamber. The detector is operated at liquid nitrogen temperature, and the resistivity is raised close to the intrinsic level by gamma irradiation. The performance of the detector was studied using beta and cosmic ray tests. (D.L.C.)

9489 (RT/EL(64)-11) UN TERMOREGOLATORE PER ESPERIMENTI DI SPETTROMETRIA NEUTRONICA. (A Thermoregulator for Neutron Spectrometry Experiments). F. Fioroni, R. Marconero, and G. V. Pallottino (Italy. Comitato Nazionale Energia Nucleare, Rome). Oct. 1964. 12p. Dep.(mn).

Design criteria and technical characteristics of a thermoregulator for neutron spectrometry experiments are described. The apparatus operates in the temperature range from −200 to −100°C with stability and accuracy better than 0.1°C. (auth)

9490 (SGC-406R-2) DEVELOPMENT OF EQUIPMENT TO CONDUCT AREA SURVEY MEASUREMENTS OF THE ELECTROMAGNETIC PULSES FROM NUCLEAR EXPLOSIONS. Final Report. (Space-General Corp., El Monte, Calif.). Apr. 2, 1964. 83p. (AD-603928; DASA-1499) $3.00 (OTS).

Two devices were designed to be used for measuring the peak electric or magnetic field generated by an atmospheric nuclear explosion. These devices are low-cost, rugged, battery-operated, and easily deployable instruments. One of the instruments makes measurements in discrete steps. As designed, it covers a dynamic range of 48 db in six db steps. The second device, which uses a cathode ray tube and photographic film to provide a continuous measurement scale, has a dynamic range of 54 db. (auth)

9491 (TID-21335(p.108-50)) EXPERIMENTAL INSTRUMENTATION. (Minnesota. Univ., Minneapolis. Linear Accelerator Lab.).

An outline is presented of the development of: analyzing magnets and their control systems; solid-state-detector arrays for magnetic spectrometers; general electronic equipment; a semi-windowless scattering chamber; a multiwire spark chamber; a beam monitor; and an electrostatic quadrupole. (T.F.H.)

9492 (UCRL-10980(Rev.)) PRIMARY AND SECONDARY PROTON DOSE RATES IN SPHERES AND SLABS OF TISSUE. Roger Wallace, Palmer G. Steward, and Charles Sondhaus (California. Univ., Berkeley. Lawrence Radiation Lab.). July 30, 1964. Contract W-7405-eng-48. 83p. (CONF-720-3) Dep.(mn); $3.00(cy), 2(mn) OTS.

From 2nd Symposium on Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., Oct. 1964.

A code was developed for the depth-dose relation in spheres of tissue due to primary protons and to cascade, evaporation, and hydrogen elastically scattered secondary protons. Hydrogen elastically scattered protons are assumed to be emitted in the forward direction, as also, on the basis of Metropolis's calculations, are cascade protons. Evaporation protons are assumed to deposit their dose locally. It is shown that the dose rate at a depth d in a slab due to a normally incident parallel broad beam of protons is the same as the dose rate at the center of a sphere of radius d when an isotropic flux is incident upon the sphere. The depth-dose results were checked by experiments using 730-Mev protons, and compared with Monte Carlo calculations performed at Oak Ridge for 400-Mev protons. The results show that the depth-dose pattern varies widely with proton energy and sphere size. For certain intermediate proton energies, the primary protons cause a peak dose rate at a predictable depth in the sphere. The secondary proton dose rate increases with increasing incident proton energy, sphere size, and depth. Protons of 730 Mev cause a secondary proton dose at the center of a 2.5-cm-radius sphere which is 14% of the total dose, 35% for a 10-cm radius, and 48% for a 25-cm radius. (auth)

9493 (UCRL-11517) SPARK-GAP-TRIGGER AMPLIFIER. Quentin A. Kerns and Harold W. Miller (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 20, 1964. Contract W-7405-eng-48. 13p. (CONF-799-10). Dep.(mn); $1.00(cy), 1(mn) OTS.

From 11th Annual Nuclear Science Symposium, Philadelphia, Oct. 1964.

Short over-all time delay, low time jitter, and excellent long-term reliability are among the desirable features designed into a pulse generator that produces a 2-Mw output pulse 30 nsec after the application of a 1 v signal at its 50-ohm input connector. The 10-kv output pulse can be used to trigger simultaneously several spark gaps of the type used in spark-chamber pulse modulators. The 10^8 power gain of the spark-gap-trigger amplifier is achieved by four stages of amplification packaged in a 5¼ in. rack-mount chassis that operates directly from a 117-v line. The individual stages, each selected to give minimum time delay for a given power gain of their respective power levels are: avalanche transistors, planar triode, grounded-grid planar triode, and triggered-spark gap. During 10 months of operation, there have been no failures and no adjustments necessary in any of seven spark-gap trigger amplifiers used in various spark-chamber experiments. (auth)

9494 (UCRL-11738) SEMILOGARITHMIC AMPLIFIER SYSTEM. W. W. Goldworthy (California. Univ., Berkeley. Lawrence Radiation Lab.). Oct. 1964. Contract W-7405-eng-48. 18p. (CONF-799-7). Dep.(mn); $1.00(cy), 1(mn) OTS.

From 11th Annual Nuclear Science Symposium, Philadelphia, Oct. 1964.

An amplifier system is described that can compress several decade pulse height ranges into several linear step gain ranges covering only a single decade. Rather than employing the usual frequency, voltage, and temperature-dependent low-voltage semiconductor switching and conduction characteristics, this amplifying system utilizes the reproducible, easily calibrated, abrupt, high level limiting characteristics of a transistor operational feedback amplifier. The several cascaded stages of this amplifier, whose individual outputs drive a pulse adder, use these abrupt, high level limiting characteristics to determine the boundaries between several well defined linear step gain ranges as a function of pulse amplitude. The gain in each of these ranges is established by that gain available prior to the point where limiting occurs in the amplifier system. Such an amplifying system has application in the measurement of wide range nuclear or other pulse height spectra, where the relatively poor resolution uniformity of multichannel analyzers either dictates an unreasonable number of available channels or the use of some sort of compression amplifier. (auth)

9495 (UCRL-12150) DETERMINING SCINTILLATOR RESPONSE TO PHOTONS AND NEUTRONS BY MONTE CARLO. Charles M. Ankenbrandt (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 30, 1964. Contract W-7405-eng-48. 30p. Dep.; $2.00 (OTS).

The Monte Carlo method is used to calculate the response of a standard scintillation detector to gamma rays and neutrons in the energy ranges $0.1 \leq E \leq 10$ Mev and $0.1 \leq E \leq 14$ Mev, respectively. The results for gamma rays are compared with an analytic approximation and also with experimental measurements of sensitivity made at three different gamma energies. Agreement is within the combined errors of the Monte Carlo prediction and the experimental results. In the Monte Carlo neutron problem, light output from the scintillator as a function of time is obtained. Also the relative contribution to total light output from each of the possible processes for neutron interaction in the scintillator is given. (auth)

9496 (UJV-1136/64) THE AXIAL ASYMMETRY EFFECT ON THE FOCUSING OF A FLAT-TYPE β SPECTROMETER. A. Spalek (Cěskoslovenska Akademie Ved. Ustav Jaderného Vyzkumu, Řež). [1964]. 12p. Dep.(mn).

The equations describing electron trajectories upon introduction of small axial asymmetries in the magnetic fields of flat beta spectrometers are solved, in order to determine the effects of the asymmetries on the focusing properties of the spectrometer. (T.F.H.)

9497 (CEA-tr-A-1715) MESURE DE FLUX QUASI MOMENTANÉ AVEC UN DÉTECTEUR AU RHODIUM POUR FLUX BÉTA. (Measurement of Quasi-Instantaneous Flux with a Rhodium Detector for Beta Flux). S. Hagen. Translated into French from "Euratom Symposium on Dosimetry, April 4, 1963, Brussels." 12p. Dep.(mn); \$1.60(fs), \$0.80(mf) JCL.

The principle of measuring quasi-instantaneous neutron flux using Rh as the beta emitter was reviewed, and the design of the detector was outlined. The calibration and linearity of the detector, and its behavior in a variable neutron flux, were determined. The results show that the Rh detector is a satisfactory instrument to measure neutrons for slow flux variations, and it offers special advantages. (J.S.R.)

9498 CLOUD CHAMBER FOR OPTICAL MEASUREMENTS OF AEROSOLS. Edward Speyer (American Machine and Foundry Co., Springdale, Conn.). Appl. Opt., 2: 207-15(Feb. 1963).

The construction is described of a cloud chamber in which various optical measurements of meteorological interest can be made. It consists of a refrigerated chamber of four m^3, containing a mirror system permitting a range of optical path lengths up to 56 m. The design of the optical system is explained, together with construction details of the chamber and a description of the two radiation detector systems. The chamber is a sheet metal cylinder 148 cm high and 185 cm in dia, insulated, and maintained between 8 and 11°C. If a cloud of only low turbidity is needed, one or more spray nozzles can be used for generating the cloud. Clouds of high turbidity are obtained by injecting steam into the chamber. To avoid warming the chamber, the steam is generated outside the chamber in a pressure vessel (made from an ordinary pressure cooker) fitted with a needle valve control and a pressure gauge. To keep the pressure in the vessel steady, and to minimize the heat needed (a 2000-w heater is used) the sides of the vessel are wrapped with insulation. Usefulness of the chamber for transmissivity vs distance measurements and for scattering vs transmissivity measurements is indicated by examples of results obtained. Such measurements also can be used to calculate aerosol absorptivities. Thus, cloud chamber measurements may provide an indication of the mean free path of a photon before it is absorbed. Most of the absorbed photons have been scattered out of the direct beam; therefore, it is necessary to measure the attenuation of the scattered light, which means a wide-angle (actually a hemispherical) detector must be used. The problem is considered as analogous to that encountered in analyzing by means of x rays or neutrons the scattering and absorption in a slab. Neutron absorption can sometimes be distinguished from neutron scattering by γ-ray emission, and analogous optical techniques using fluorescent dyes in the described apparatus can be used. (BBB)

9499 APPLICATION OF LIPPMANN-TYPE EMULSION TO AUTORADIOGRAPHY WITH AN ELECTRON MICROSCOPE. Philippe Granboulan and Roger Audran (Institut de Recherches sur le Cancer, Villejuif, France and Laboratoire de Recherches Kodak-Pathe, Vincennes, France). Compt. Rend., 259: 3201-4(Nov. 9, 1964). (In French)

A technique for the utilization of Lippmann-type emulsions in electron microscopic autoradiography is presented and discussed. Their low sensitivity and high gelatin concentration pose problems. The sensitivity of extremely fine grains applied in thin films by centrifugation to beta particles from tritium can open the field of molecular biology to autoradiography. (tr-auth)

9500 AN AUTOMATIC RECORDING FLOW MONITOR FOR BETA RADIATION. Richard H. Mandl (Boyce Thompson Inst., Yonkers, N. Y.). Contrib. Boyce Thompson Inst., 22: 405-7(July-Sept. 1964).

The specifications of automatic recording analyzers, for such biological materials as amino acids, peptides, proteins, sugars, and nucleic acids, using a flow monitor to measure radioactivity are discussed. Flow scintillation counters have been developed using anthracene as the scintillating phosphor with an efficiency of 38% for ^{14}C with a background of 18 cpm, but anthracene may be unsuitable due to solution of the phosphor by certain eluting solvents used in some analytical procedures. Therefore some sensitivity was sacrificed and a slightly less efficient plastic scintillator was used which would be more resistant to solvents. By choice of selected components, a simple, single channel system could be used without seriously affecting efficiency. The diagram of the system is illustrated along with a detailed drawing of the flow cell. The components of the system include, as the detector, a flow cell specially constructed and consisting of a Lucite block (2 in. circle × $^1/_2$ in.) containing three cylindrical grooves filled with NE-102 plastic phosphor (100 to 200 mesh). The flat face of the Lucite cell was placed in close contact with the end of a 14-stage photomultiplier, the cell being mounted in a cast lead box 1-in. thick. The rest of the monitor consisted of a single-channel analyzer, a scaler with high-voltage supply, ratemeter, and a 1-ma recording galvanometer. Using a voltage of 1050 and an infinite window, an efficiency of 32% for ^{14}C was achieved with a background of 250 cpm. Loss in efficiency to about 26% and a background of 100 cpm occurred if a 10% window were used. This design was used successfully in monitoring ^{14}C-labeled amino acids and other column effluents. For example, the eluate from a cation-exchange resin was successfully monitored even though the concentration of the fluid reached 6$\underline{N}$ HCl; this concentration would have had a serious effect if material other than plastic were used. (BBB)

9501 A WHOLE-BODY COUNTER. H. Muth and E. Oberhausen (Universität der Saarlandes, Homburg/Saar, Ger.). Ergeb. Med. Strahlenforsch., 1: 528-56 (1964). (In German)

Ideally, a radiation detector for a whole-body counter must have several characteristics. These are maximal absorption of the incident γ rays, a large detection volume so that a relatively large proportion of the γ rays from the person being measured will be collected, a linear relation between the absorbed γ-ray energy and the signal output, a high input-output signal efficiency, and a narrow range of fluctuation in signal output. The advantages and disadvantages of solid crystals, liquid, and plastic scintillation detectors are discussed and related to the electronic circuitry required in a whole-body counter. The importance of the contribution of background radioactivity to measurements of the small amounts of radioactivity in humans is evaluated, and procedures for calibration of whole-body counters are described. In general, whole-body counters simplify the detection of labeled compounds or radioelements administered to humans. Without access to a whole-body counter the only other procedure is to measure the excretion of the radioisotope. Often this is impracticable over extended periods of time, because, for instance, if 5% of an administered radioisotope is absorbed, and 95% of this is excreted, its measurement with an accuracy of 5% will make the results fall within the range of its resorption. On the other hand, if the whole-body content is measured with an accuracy of only 20%, it can still be concluded that resorption amounts to a value between 4 and 6%. Studies where whole-body counters have been used include, as examples, measurement of the naturally occurring ^{40}K in persons with muscular disorders, resorption of orally administered ^{59}Fe, resorption and biological half times of ^{60}Co-labeled vitamin B$_{12}$, measurements of total-body Na with ^{22}Na and ^{24}Na, measurement of the biological half time of R^{131}ISA and measurement of inorganic ^{131}I retention as an indication of thyroid carcinoma metastases. One very important use is measurement of ^{47}Ca and ^{85}Sr in bone mineral studies. (BBB)

9502 THE RADIUM GAMMA RAY RESPONSE OF MUSCLE-EQUIVALENT IONIZATION CHAMBERS. Jacob Kastner and R. K. Hukkoo (Argonne National Lab., Ill.). Health Phys., 11: 50-2(Jan. 1965).

An extrapolation to zero-wall thickness of the response of a large ion chamber constructed of muscle-equivalent conducting plastic and filled with a muscle-equivalent (M.E.) gas mixture was made. This was done by adding M.E. shells of known thickness to a 2 mm M.E. wall, 8 in. dia, sealed chamber filled with M.E. gas. The ionization observed at small wall thickness (1-2 mm) was rather high compared with that previously reported. The volume and capacitance of the chambers were measured to better than 0.5%. Values obtained for ionization rates are given. It was concluded that such large muscle-equivalent chambers may be used with confidence to provide absolute measures of the absorbed dose. (P.C.H.)

9503 PHOTOMULTIPLIER "FATIGUE" EFFECTS. C. J. Karzmark (Stanford Univ., Palo Alto, Calif.). Health Phys., 11: 54-6(Jan. 1965).

A review is presented on developments in gain variation or fatigue effects in photomultiplier tubes. Temperature, light intensity, and exposure time influence the fatigue effect as well as subsequent recovery. Encouraging preliminary results from aging techniques have been reported for PM tubes used in a radiophotoluminescence reader. Drift stability is improved by leaving the EHT on continuously. (P.C.H.)

9504 DEVELOPMENT OF SECTOR TYPE DOUBLE-FOCUSING β-RAY SPECTROMETER. Hidetsugu Ikegami (Tokyo Univ.) and Kenji Takumi. Hitachi Hyoron, 46: 623-31(Apr. 1964). (In Japanese)

A sector-type magnet was used for analyzing the energies of various charged particles from accelerators. It is applicable in β spectrometers, although difficulty arises from the magnetic-end effect in constructing accurate spectrometers. Compared with conventional spectrometers, the sector-type, double-focusing β spectrometer developed has the following advantages: high resolution (better than 0.5%), high aperture, high versatility, and low cost of construction. Using the spectrometer with the magnetic flux density range from 442 to 22.6 G and electron orbit radius of 34 cm, the energy of electrons from 4 Mev to 50 kev was accurately determined. Assuming the base width of a spectrum to be twice the half width of the spectrum, the resolution, R, of this spectrometer is given by $R = \Delta p/p = \frac{1}{2}(\Delta x_2^*/D)$. Here, Δp is the half width of the spectrum line, p is the moment of the electron that is detected, Δx_2^* (Ikegamis' approximation function) represents the spread of the image at the focus point, and D represents the dispersion. The theoretical resolution of this spectrometer with a line source of 1 mm in width and 3 mm in height is about 0.05%, and an experimental resolution under the corresponding conditions was 0.1%. (NSA of Japan)

9505 DESIGN OF AMPLITUDE DISCRIMINATORS USING TUNNEL DIODES. Bohumil Sojka (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež). Jaderná Energie, 10: 259-61(1964). (In Czech.)

Fast amplitude discriminators using Czechoslovakian and Soviet tunnel diodes are described. Each discriminator contains a discrimination circuit and a shaping circuit, operating in the monostable region. Four amplitude discriminators using the same tunnel diode in the discrimination and shaping stage were tested. With the Czechloslovakian diode DTI, an input sensitivity of several millivolts was achieved, while the maximum input impulse which did not give rise to a parasitic output pulse was 10 volts. The amplitude of the output impulse was about 0.3 volt, the width 20 nanoseconds, and the rise time less than 10 nanoseconds. With the Soviet diodes, the results were similar, but the input sensitivity was somewhat lower. The circuit is used in conjunction with a radiation detector which gives very steep impulses (of the order of a nanosecond). It is possible to use the circuit either as an integral discriminator or in coincidence apparatus, where there is a question of extreme requirement for time resolution. The diodes are less suitable for the construction of differential discriminators. (TTT)

9506 A CONTRIBUTION TO THE PROBLEM OF EXCESSIVELY IRRADIATED FILM DOSE METERS. Jaroslav Beneš and Jiřina Matoušková (Inst. of Nuclear Research, Czechoslovak Academy of Sciences, Řež). Jaderna Energie, 10: 403-5(1964). (In Czech.)

The possibility of using silver determination in developed films for evaluation of excessively irradiated film dose meters was investigated. The optical density of a developed film was almost directly proportional to the silver content. The accuracy of silver determination in cases of high blackening was greater than the accuracy of density measurement by densitometer. (auth)

9507 RESPONSE OF GEIGER MÜLLER COUNTER TO INTENSE PULSED PHOTON BEAM. Masakuni Narita and Yasutomo Czawa (Hokkaido Univ., Sapporo). Oyo Buturi, 33: 801-5(Nov. 1964). (In Japanese)

The pulses G-M counters produce in intense pulsed photon beams are higher than those normally observed at the same applied counter voltage. These pulses are formed by superposition of the electrons generated in proportion to the beam intensity onto the electrons produced by characteristic discharge of the counter. Theoretical derivations made to express these composite pulses were verified experimentally by the use of an analog computer and counters of several kinds exposed to a photon beam from a 4-Mev electron linear accelerator. Furthermore, some tubes were found to produce several output pulse patterns in an extremely intense field. (auth)

9508 MAGNETIC SPECTROMETER FOR ELECTRONS WITH ENERGIES TO 100 Mev. N. G. Afanas'ev, A. V. Vysotaskaya, V. A. Gol'dshtein, A. V. Dem'yanov, and V. I. Startsev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 5, 48-54(Sept.-Oct. 1964). (In Russian)

The calculation method, construction, and results of experimental corrections for a double-focusing magnetic spectrometer with a homogeneous field are described. The spectrometer has a circular boundary ensuring ideal horizontal and satisfactory longitudinal focusing. Magnetic screens are installed at the inlet of the spectrometer. The resolving power of the spectrometer with ϕ2 and 4 mm source is 0.2 and 0.4%, respectively, at an angle of capture at the median plane of 180°. Calculations were made of the fourth order horizontal aberrations and the third order vertical aberrations. (tr-auth)

9509 HYDRODYNAMIC INVESTIGATION OF BUBBLE CHAMBER PERFORMANCE. Yu. A. Budagov, V. P. Dzhelepov, V. G. Ivanov, Yu. F. Lomakin, V. B. Flyagin, and P. V. Shlyapnikov (Joint Inst. for Nuclear Research, [Dubna, USSR]). Pribory i Tekhn. Eksperim., No. 5, 55-60(Sept.-Oct. 1964). (In Russian)

Hydrodynamics of bubble chamber performance were investigated, and formulas relating the oscillation periods and amplitudes in the working liquid with the physical properties, basic chamber dimensions, and parameters of the expansion system were derived. (tr-auth)

9510 RECORDING OF PARTICLES IN A SPARK CHAMBER WITH A LARGE INTER ELECTRODE GAP. B. A. Dolgoshein, B. I. Luchkov, G. G. Moiseev (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 5, 60-4(Sept.-Oct. 1964). (In Russian)

The precision of spark localization of the particle trajectories at angles of 0 to 60° to the direction of the electric field was measured in a spark chamber with one 10 cm inter electrode gap. The spurious track curvature was also measured. (tr-auth)

9511 DIFFERENTIATION OF PARTICLES ACCORDING TO MEASUREMENTS OF IONIZATION PARAMETERS

AND THEIR TRACKS IN NUCLEAR PHOTOEMULSIONS. F. G. Lepekhin (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 5, 65-70(Sept.-Oct. 1964). (In Russian)

General concepts and regularities in the boundary theory were used for particle differentiation according to their ionization parameters and track densities in the emulsion. The derived formula was used for estimating the relative specific energy losses by the density of particle clusters over a wide range of ionization parameters. (R.V.J.)

9512 RECORDING OF NUCLEAR FISSION EVENTS BY GLASS AND MICA. A. Kanustsik, V. P. Perelygin, and S. P. Tret'yakova (Joint Inst. for Nuclear Research, [Dubna, USSR]). Pribory i Tekhn. Eksperim., No. 5, 72-5(Sept.-Oct. 1964). (In Russian)

An estimate was made of the photoglass, phosphate glass, and mica recording efficiency for nuclear fission events. The results showed the efficiency of 42 ± 4, 67 ± 5, and 83 ± 5%, respectively. The photoglass recording threshold for fission fragments was at ~15 to 20 Mev. (tr-auth)

9513 METHOD FOR MEASURING CHARGED PARTICLE MASSES WITH AUTOMIZED SELECTION OF IONIZATION STOPS IN SCINTILLATORS. K. Sh. Egiyan. Pribory i Tekhn. Eksperim., No. 5, 75-8(Sept.-Oct. 1964). (In Russian)

An improved method is suggested for measuring charged particle mass by means of automized selection of ionization stops in scintillators and using residual energy and track measurements. (R.V.J.)

9514 TWO-DIMENSIONAL AMPLITUDE-TIME SPECTROMETER. R. G. Ofengenden, F. N. Berezin, G. B. Lyubanskii, and M. A. Shaleiko (Inst. of Physics, Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 5, 81-7(Sept.-Oct. 1964). (In Russian)

Descriptions are given of an installation for measuring amplitude spectra for 8 selected time intervals in 255 time range channels. The beginning of the range was set at (0 to 15) × 64 in relation to the neutron pulses. The width of the time channel was 2, 4, 8, 16, 32, 64, or 128 μsec. Each time interval was equal to 1 to 8 channel widths with 64 × 8 amplitude channels. With a drum with 64 pulse channels, the total number of channels is 4096. The pulses were recorded in a decimal system at a printing speed of >500 numbers per minute. (tr-auth)

9515 "A WINDOW" IN SEMICONDUCTOR SPECTROMETER FOR CHARGED PARTICLES. A. K. Mednikov, N. I. Stroikin, and A. A. Babushkin (Kazakh State Univ., Alma-ata, SSR). Pribory i Tekhn. Eksperim., No. 5, 87-92(Sept.-Oct. 1964). (In Russian)

Descriptions are given of a silicon surface-barrier nuclear emission detector coated with 0.15 to 3.80 and 0.37 × 1.20 mg/cm^2 films of Au and Al, respectively. The influence of the coating on the amplitude resolution of the detector was found. The energy losses in thin layers of the substance, in particular in Au, was determined by the surface-barrier semiconductor detector during the α-particle passage. The mean excitation energy of Au is 900 ev. (tr-auth)

9516 MULTICHANNEL SCHEME FOR COINCIDENCES AND ANTICOINCIDENCES WITH A SMALL RESOLVING TIME. A. F. Dunaitsev and Yu. D. Prokoshkin (Joint Inst. for Nuclear Research, [Dubna, USSR]). Pribory i Tekhn. Eksperim., No. 5, 93-9(Sept.-Oct. 1964). (In Russian)

A design is given of a multichannel bridge type coincidence and anticoincidence scheme with a resolving time, measured with a meson(π) beam, of ~1/nsec. The efficiency of anticoincidences exceeds 0.998. (tr-auth)

9517 MULTICHANNEL SCHEME FOR COINCIDENCES-ANTICOINCIDENCES OF NANOSECOND RANGE IN SEMICONDUCTORS. I. F. Kolpakov (Joint Inst. for Nuclear Research, [Dubna, USSR]). Pribory i Tekhn. Eksperim., No. 5, 99-102(Sept.-Oct. 1964). (In Russian)

A 4-channel coincidence scheme with one-anticoincidence channel operating on the principle of current interference at a tunnel diode, with an inlet pulse former to the transistor is described. Tests with fast scintillation counters operating with α sources with 1 M cable indicated the resolving time of 10 nsec for coincidences and 7 nsec for anticoincidences at a resolving curve decrement of 5 and 3 nsec for coincidences and anticoincidences respectively. The scheme selectivity coefficient is ~10, the anticoincidence efficiency is ~10^{-3}, and the dead time is 30 nsec. The time characteristics do not vary at temperatures up to 50°C. The amplitude range of incoming pulses is 0.15 to 8 v. High-frequency diffusion triodes with maximum frequency of 700 Mc, D 10 diodes, and a p-germanium tunnel diode with maximum current of 10 ma are utilized in the scheme. (tr-auth)

9518 AUTOMATIC SELECTION OF IONIZATIONS STOPS OF CHARGED PARTICLES IN SCINTILLATION TELESCOPE. K. Sh. Egiyan and S. V. Vartanyan (Inst. of Physics, State Commission on Utilization of Atomic Energy, USSR). Pribory i Tekhn. Eksperim., No. 5, 103-6(Sept.-Oct. 1964). (In Russian)

A radioscheme is given for automatic selection of events with three simultaneous signals connected by the relation $A(U_2/U_3)^{\gamma} - B(U_1/U_3)^{\gamma} = C$ (where A, B, C, and γ are constants and U_1, U_2, U_3 are signal amplitudes). The design is based on the transformation of the two pulse amplitudes into a pulse with an amplitude proportional to the two incoming pulses. The design was used for determining charged particle mass by means of a scintillation spectrometer. (tr-auth)

9519 A PRECISION AMPLIFIER FOR OPERATION WITH PULSE IONIZATION COUNTERS. A. S. Eremin, B. S. Rozov, and D. F. Nenarokov (Inst. of Engineering Physics, Moscow). Pribory i Tekhn. Eksperim., No. 5, 107-11(Sept.-Oct. 1964). (In Russian)

Descriptions are given of a scheme for charge pulse conversion in transistorized, long-life tube ionization chambers. Parameters of the amplifier and its sections are analyzed. (tr-auth)

9520 SYSTEM OF UNIVERSAL MODULES FOR SCINTILLATION COUNTERS. I. A. Golutvin and Yu. V. Zanevskii (Joint Inst. for Nuclear Research, [Dubna, USSR]). Pribory i Tekhn. Eksperim., No. 5, 114-19 (Sept.-Oct. 1964). (In Russian)

Descriptions are given of universal modules designed for scintillation counters with the first pulse former used for standardization of pulses emitted from a scintillation counter. A four-channel coincidence or anticoincidence scheme is included. The second pulse former acts as a discriminator. The module also contains a wide-band amplifier. The coincidence resolving time is several nanoseconds. All schemes were developed as two-dimensional 34 × 82 mm^2 modules. (tr-auth)

9521 FAST-ACTING SEMICONDUCTOR SCHEME FOR MULTIPLE COINCIDENCES. A. F. Dunaitsev (Joint Inst. for Nuclear Research, [Dubna, USSR]). Pribory i Tekhn. Eksperim., No. 5, 119-20(Sept.-Oct. 1964). (In Russian)

Descriptions are given of a transistorized bridge-type multiple-coincidence scheme. The resolving time for a charged meson beam is ~2 nsec. (tr-auth)

9522 PREAMPLIFIER FOR SEMICONDUCTOR DETECTORS FOR CHARGED PARTICLES. B. V. Fefilov (Joint Inst. for Nuclear Research, [Dubna, USSR]). Pribory i Tekhn. Eksperim., No. 5, 121-2(Sept.-Oct. 1964). (In Russian)

The design of a charge-sensitive preamplifier tube is described. A triode 6C3P is used as the input tube. The noise line width is not >12 kev with the external capacitance at the entrance of 100 nF (integration and differentiation time constants are 0.5 to 0.8 μsec, respectively). (tr-auth)

9523 A 4π GEOMETRY DEVICE FOR STUDYING TIME CORRELATION OF PHOTONS EMITTED BY VARIOUS GAS ATOMS. Yu. F. Skachkov (Inst. of Nuclear

Energy, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 5, 168-71(Sept.-Oct. 1964). (In Russian)

A design is given of an installation for photon time correlation. The use of the light collection 4π geometry and liquid-nitrogen cooled photomultipliers created sufficient sensitivity necessary for studying time correlation of separate photons in gas atoms excited by electron collision. (tr-auth)

9524 A HYDROGEN LIQUEFIER (VO2) ADAPTED TO LARGE LIQUID HYDROGEN CHAMBERS. A. G. Zel'dovich and Yu. K. Pilipenko (Joint Inst. for Nuclear Research, [Dubna, USSR]). Pribory i Tekhn. Eksperim., No. 5, 203-6(Sept.-Oct. 1964). (In Russian)

A hydrogen liquefier with an efficiency of 230 l/hr for normal hydrogen and 140 l/hr for para-hydrogen is described. Production of liquid para-hydrogen is discussed. (tr-auth)

9525 A ONE GIGACYCLE BINARY COUNTER. William C. G. Ortel (Bell Telephone Labs., Inc., Murray Hill, N. J.). Proc. IEEE (Inst. Elec. Electron. Engrs.), 52: 1746-7(Dec. 1964).

A description is given of the design of a three-stage binary counter circuit using tunnel diodes and having a resolving time of 0.8 nsec and a counting rate capability of 1.2 Gc. Very high speeds are achieved by coupling the stages inductively from the memory loop of one stage to the input loop of the next, without the use of active or nonlinear buffer elements. (M.J.T.)

9526 EXPERIENCES WITH DOSIMETRIC FILM RADIATION PROTECTION CONTROL IN THE DDR. W. Degner, H. Hegewald, H. Danders, and K. Krueger (Universität, Berlin). Radiobiol. Radiother., 3: 173-82(1962). (In German)

Because of the good contrast produced between the quality-dependent darkening observed with dosimeters developed at this hospital it is possible to ascertain the nature of impingent radiation, and to evaluate the incident dose with an accuracy of 30%. The energy dependence of the film emulsion used is related to the relatively high atomic numbers of the Ag and Br used. Bremsstrahlung of 80 kv can be differentiated from 200 kv bremsstrahlung because the photoelectric effect is more important at 80 kv, while the Compton effect is greater at 200 kv. For radioelements, such as ^{131}I, ^{137}Cs, ^{60}Co, and Ra, with higher energies, the blackening of the film at 400 mR, 1.2 R, and 2 R is related to the wavelength of the radiation. Results of the studies with dosimeters used in 1960 to measure radiation exposure in monthly exposure ranges of less than 25 mR, 25 to 200 mR, 200 to 400 mR, and greater than 400 mR show that among personnel of the medical installations of the DDR who use x rays over 90% have received less than 25 mR/month. For the same interval the natural environmental radiation amounts to ~10 mr. During this period the few exposures that exceeded 25 mr were due to carelessness or participation in experimental studies. Of the persons that utilized radioisotopes, except Ra, it is estimated that no more than 2 or 3% receive an exposure greater than 100 mR/month. It is probable that in 1960 no more than 20 persons received as much as the 5 R/yr permissible in occupational exposure. Reduction of radiation exposure in persons who work with Ra has improved considerably for the period 1957 to 1960. In 1957 more than 70% received monthly exposures from Ra of up to 400 mr, while almost 30% received more than 400 mr for this same interval. By 1960 the average monthly exposure was than 100 mr for 70% of personnel using Ra. Only 10% received more than 400 mR/month. Similar percentages of ~10% were exposed to between 100 and 200 mr, and 200 and 400 mr, respectively. (BBB)

9527 FOCUSING COLLIMATOR COINCIDENCE SCANNING. Hiram E. Hart (Montefiore Hospital, New York; City Univ., New York, and Brookhaven National Lab., Upton, N. Y.). Radiology, 84: 126(Jan. 1965).

An essentially composite type of scanning, namely, focusing collimator coincidence scanning (F.C.C.S.) was found to be possible by setting the pulse height window of any standard scanner for the sum of the energies of two gammas or of a gamma and x ray where only coincidences are recorded. A 3 in. dia collimator having about 10% geometric efficiency for a point source at the focus was constructed as a working model for the much larger crystal collimator assemblies indicated for practical application (dia of about 12 in.). An approximate eightfold improvement in resolution by volume was noted for F.C.C.S. in the gamma image of an ^{125}I source. (P.C.H.)

9528 DEPTH-DOSE SCANNING DEVICE. Walter Mauderli and Bowdien Hazard (Univ. of Florida, Gainesville). Radiology, 84: 130-1(Jan. 1965).

A mechanical guiding device was constructed for the ionization chamber, which allows adjustable scanning widths up to 50 cm and a maximum scanning depth of 60 cm. The scanning lines are spaced 1 cm apart. The output signal is utilized to activate a modified IBM Selectric typewriter, to print 10, 20%, etc., isodose points. The scanning speed is adjustable and depends on the frequency response of the amplifier. The speed presently used is 4 cm/second. The scanning of an area of 30 × 35 cm takes slightly less than 5 min. (P.C.H.)

9529 SYSTEMS FOR DETECTION, TELEMETRY, AND REGISTRATION FOR MEASUREMENT OF COSMIC RADIATION AT HIGH ALTITUDE. Alberto M. Godel, Horacio S. Ghielmetti, and Juan G. Roederer (Universidad, Buenos Aires). Rev. Inst. Ing. Elec., 2: 67-8(Feb. 1964). (In Spanish)

Aerial and terrestrial equipment used in the detection of natural and artificial atmospheric radiation is described. Experiments were performed using a Geiger-Mueller double detector apparatus, with simultaneous recording of pressure and temperature data. The different parameters are transmitted by a PAM/FM frequency division system. The carrier used was operated at 73 Mc/sec provided by a tube-type emitter with an output of ~ 200 mw. Details are also given of the source of A.T. for detector polarization, the primary input, characteristics of the balloons utilized, and the gondola. Mention was made of the testing of equipment for the detection of x radiation, by a NaI (Tl-activated) scintillation detector with photomultiplier and discriminators for energy levels of 20 and 60 kev. To these were added two Geiger-Mueller detectors, a pressure transductor, and a five-channel telemetry system. The A.T. source requirements were listed, as well as the equipment's total wt. A description was given of the receiving station and work in progress directed towards obtaining data directly on perforated tape. The results of 24 launchings show that this equipment meets the efficiency and reliability standards required in average 7-hr flights and at 350-km distances. Mention was also made of the generally high rate of instrument recovery. (BBB)

9530 LOCKED rf SPECTROMETER FOR NUCLEAR QUADRUPOLE RESONANCE. Richard J. Volpicelli, B. D. Nageswara Rao, and John D. Baldeschwieler (Harvard Univ., Cambridge, Mass.). Rev. Sci. Instr., 36: 150-3 (Feb. 1965).

A technique is described for locking a r-f spectrometer to a pure quadrupole resonance signal. Since the quadrupole resonance frequency of a nucleus in a solid can be quite sensitive to changes in temperature and pressure, a quadrupole resonance signal is of potential interest in the measurement of these variables. The application of a locked r-f spectrometer as a precise nuclear resonance thermometer is evaluated using the ^{35}Cl resonance of $KClO_3$ powder. The precision of this device as a thermometer is about ±0.002°K, and the system is capable of tracking a temperature change of at least 2°K/min. The locked quadrupole spectrometer appears to have promise as an absolute temperature standard. (auth)

9531 LARGE-FORMAT SPARK CHAMBER CAMERA WITH TEN-MILLISECOND DEADTIME. Robert W. Williams, Oscar R. Sander, and Heinz Guldenmann (Univ. of

Washington, Seattle). Rev. Sci. Instr., 36: 161-4(Feb. 1965).

A camera is described which will take six photographs with stationary images and good optics in a total time of 40 msec. It is designed to record spark chamber events in experiments at pulsed accelerators in which the trigger rate during the pulse is high. Independently movable plane mirrors are positioned between the lens and the six separate films. After a photograph is recorded on one film the associated mirror is removed, allowing the image to fall on the next film. The films are advanced during the accelerator offtime. The frame size is 29 × 41 mm. Tests show a slight loss of resolution due to the presence of a mirror. The resolution was the same in pictures taken 10 msec apart as in static test pictures. (auth)

9532 PRINTED-CIRCUIT MODULAR INSTRUMENTATION SYSTEM. Arpad Barna (Stanford Univ., Calif.), J. Howard Marshall, and Daniel F. Torzewski. Rev. Sci. Instr., 36: 166-73(Feb. 1965).

A transistorized modular instrumentation system for handling photomultiplier signals from scintillation and/or Cherenkov counters in high energy physics experiments is described. The experimenter has available a multiplicity of operations, such as coincidence determination, gating, amplitude discrimination, multiplexing, mixing, amplification, and pulse-height analysis. System design considerations emphasize direct interchangeability of modules to minimize calibration procedures. Particular emphasis was placed on the stability and linearity of the amplifying, gating, and mixing circuits, so that 1% pulse-height resolution may be meaningfully achieved. High speed coincidence and gating circuits are available, in which pile-up effects were minimized to allow operation at counting rates of up to 10 Mc. In experiments where manual data reduction is feasible, the outputs of the system are displayed via scalers and/or commercial pulse-height analyzers; in more complex experiments, the outputs may be further processed through a digital computer. (auth)

9533 TIME RESOLUTION OF PHOTOMULTIPLIER SYSTEMS. L. G. Hyman (Argonne National Lab., Ill.). Rev. Sci. Instr., 36: 193-6(Feb. 1965).

Results on the ability of a photomultiplier system to resolve time differences are presented in graphic form. The results are presented in parametric form and hence may be applied to a wide variety of scintillator-photomultiplier combinations, provided the system is reasonably approximated by the model used. In addition to the usual effects included (scintillator lifetime, pulse shape, transit time spread), the model includes the effects of finite risetime in the scintillation process. (auth)

9534 OPTIMUM THICKNESS FOR STEARATE "GRATINGS" FOR SOFT X RAYS. Robert P. Frans and Franklin D. Davidson (Univ. of Arizona, Tucson). Rev. Sci. Instr., 36: 230-1(Feb. 1965).

Measurements of intensity and spectral peak width from a series of stearate pseudogratings having an increasing number of deposited films were made. The gratings consisted of lead stearate monolayers built up on a substrate of barium stearate with mica as a base. The gratings were employed flat in the windowless tube helium path spectrometer in order to compare them with real crystals of long spacing. To permit such comparisons the x rays used were the relatively hard K spectral lines of Al and Na. (C.E.S.)

9535 RADIATION DETECTORS AND MEASUREMENT INSTRUMENTS IN MEDICINE. PART 1. G. Schoknecht (Staedtische Auguste-Viktoria-Krankenhauses, Berlin). Roentgen-Lab Praxis, 15: R38-45(Feb. 1962).

The effects most often used for measurement of radiation are gas ionization, excitation of fluorescence, and conductivity changes in crystals. Ionization chambers consist of gas filled chambers, where the chamber wall forms a cathode and the anode is located centrally. The movements of electrons produced within the chamber by the incident radiation result in an electrical pulse. Ionization chambers vary in form, size, and the gas used. If x ray units (R) are to be measured, air may be used. Condenser chambers are used after calibration to measure total radiation dose. Other types of ionization chambers are used to measure radiation dose intensity. In proportional counting tubes the gas amplification, and thus the voltage produced is directly related to the energies of the incident radiations. For this reason it is used to determine the energy of the radiation by measurement of the potential produced, and to differentiate between the type of ionizing radiation. When the voltage imposed on a counting tube is increased above the proportional region, the ionization produced by radiation becomes independent of the energy and type of radiation. Scintillation detectors are crystals, liquids, or plastics that fluoresce when irradiated. Amplification of the fluorescence produced by a photomultiplier is similar in principle to the gas amplification used in a counting tube. Each scintillation produces a pulse at the final collecting electrode in the photomultiplier. The size of the pulse depends on the intensity of the incident light or on the number of primary electrons produced at the photocathode. Some other types of crystals become conductors when irradiated. This effect depends on the alteration of the energy states of the electrons, produced by the radiation. This type of radiation probe, which requires only a very small space, is used especially for γ radiation. (BBB)

9536 RADIATION DETECTORS AND MEASUREMENT INSTRUMENTS IN MEDICINE. PART 2. G. Schoknecht (Staedtische Auguste-Viktoria-Krankenhauses, Berlin). Roentgen-Lab Praxis, 15: R72-7(Apr. 1962). (In German)

The type of radiation measurement instrument used will vary with the type of radiation pulse that is to be measured. Ionization chambers are used as integrating or cumulative pulse measurement instruments, and may be read directly and recharged by a dosimeter charger. Measurement of radiation by the current it produces requires a very sensitive galvanometer or amplifier, because of the very low direct current produced. These operate either with an electrometer tube or vibrating reed electrometer, which converts the direct current to a more detectable alternating voltage. Direct current amplifiers are also necessary in fluorescence detectors. Pulse-type survey and measurement instruments operate on the principle that a condenser-resistance circuit can be charged and discharged. They are widely used with gas discharge counting tubes. In order to detect pulses from proportional counting tubes and scintillation detectors, amplitude discriminators are necessary. The simplest type is the integral discriminator. Pulse height analysis can be carried out when two discriminators of this type are used in parallel. A further development of this type of equipment is the single channel spectrometer, which has the disadvantage that when radioisotopes with very low activity must be measured in a short interval only the pulses in the channel selected are recorded. In order to avoid this limitation multichannel analyzers can be used to reproduce a spectrum of the energy distribution of the radioisotope measured. (BBB)

9537 SCINTILLATION DEVICE FOR DISTINGUISHING WIDE ATMOSPHERIC BOMBARDMENTS AND THE DETERMINATION OF THE ANGLE OF INCLINATION OF THEIR AXES. T. T. Barnaveli and M. F. Bibilashvili. Soobshch. Akad. Nauk Gruz. SSR, 34: 545-51(1964).

An apparatus for measuring the space distribution of μ-meson components of wide atmospheric bombardments (ShAL) is described. The apparatus consists of scintillation counters distributed with photomultipliers. An impulse from each of the photomultipliers is repeated by a cathode repeater on a lamp, is branched, and again repeated at two cathode repeaters similar to the first. The impulse leaves one of the repeaters unchanged and leaves the other after being formed on a short segment of cable. A special signal-mixing device receives the signal from the cable, and then an amplifier circuit receives the impulses which are next displayed on an oscillograph where a photographic device records them. Data were presented on the specifications of the devices used, including diagrams of the circuits involved. A coordinate system was defined whereby the angle of inclination of the axis of a ShAL could be determined. The technique of determining the angle involves interpreting data from the scintillation counters to locate and measure the ShAL front. Tests with 215 bombardments revealed close agreement with prior work. An inclination angle accuracy of ±7° through proper use of the system is predicted. (auth)

9538 A TECHNIQUE FOR MEASURING NEUTRON SPECTRA IN THE RANGE 2.5 TO 30 Mev USING THRESHOLD DETECTORS. John Clayton Ringle. Thesis, Berkeley, Calif., Univ. of California, 1964. 226p.

A technique for the measurement of neutron spectra in the energy range of approximately 2 to 30 Mev uses threshold detectors as the energy-dependent neutron detectors, with the restriction that after the threshold reaction has occurred the residual nucleus must emit a gamma ray. The activity of each detector is then determined by counting it with a NaI(Tl) scintillation crystal. An investigation of various methods of calculating the neutron energy spectrum shows that three methods are acceptable: the polygonal, cross section expansion, and Legendre polynomial expansion methods. Computer programs are developed to analyze the gamma spectra, calculate the cross sections, and generate the neutron spectrum. The entire method is checked by measuring a PoBe neutron spectrum; the calculated spectrum by this method agrees quite well with previous measurements. The spectra of neutrons arising from the bombardment of Be by 25- and 33-Mev deuterons were measured by this technique. The 25-Mev spectrum agreed quite well with the neutron spectrum from 24-Mev deuterons on Be as measured previously with emulsions. Energy resolution of the spectra from the Legendre and cross section expansion methods was determined using delta-function input fluxes. (Dissertation Abstr., 25: No. 3, Sept. 1964).

9539 PRAKTICHESKIE METODY STSINTILLYATSIONNOI GAMMA-SPEKTROMETRII. (Practical Applications of Scintillation Gamma Spectrometry). N. A. Vartanov and P. S. Samoilov. Moscow, Atomizdat, 1964. 276p.

Scintillation methods, basic spectrometer parameters, and methods of calculation are discussed. Theoretical and experimental methods for determining the scintillation efficiency of NaI(Tl) and CsI(Tl) crystals were outlined. Uses of single crystal γ spectrometer and total absorption spectrometers are discussed in the last chapter. (R.V.J.)

9540 THE LPTR SINGLE-CRYSTAL NEUTRON SPECTROMETER AND REACTOR SPECTRUM MEASUREMENT. Ian Robertson Jones. Thesis, Berkeley, Calif., Univ. of California, 1964. 72p.

A single-crystal neutron spectrometer was designed and built for use at the Livermore Pool-Type Reactor. The instrument is suitable for reactor spectrum measurements, neutron diffraction work, and certain neutron cross-section measurements. Among the novel design features are neutron collimators coated with an organic compound that eliminates total reflection of neutrons from their surfaces, and a crystal orienter designed to provide a means of circumventing the problem of parasitic reflections. Design considerations such as instrument resolution, collimator design, shielding, and component precision are discussed. The calibration and alignment of the spectrometer and its individual components are described in detail. The problems of measuring reactor spectra with a single-crystal neutron spectrometer are considered individually. The equations commonly employed in the calculation of crystal reflectivity are shown to be deficient and appropriately modified equations are presented. A reactor spectrum measurement was made with the instrument and these modified equations were employed in the analysis of the data. The spectrum was measured from 0.5 to 4.0 angstroms (.327 to .0051 ev) using the (111) planes of a lead single crystal. The effective neutron temperature was found to be 361 ± 7°K, which is 51 ± 7°K above the average moderator temperature of 310°K. The experimental results are compared with a theoretical Maxwellian distribution and the differences are discussed. (Dissertation Abstr., 25: No. 3; Sept. 1964).

9541 DOSIMETER OR DOSE RATE METER WITH A SCINTILLATION COUNTER. Sydney Norman Pocock (to Philips' Gloeillampenfabrieken). German Patent 1,174,915, July 30, 1964. Priority date Mar. 1, 1961, [Netherlands].

The meter described consists of a scintillation counter followed by an amplifier the exit of which is connected to the input of a pulse generator as well as to the input of a summation amplifier via a discriminator. The summation amplifier adds the incoming pulse from the pulse generator to that portion of the pulse which has passed the discriminator. An indicating device is connected to the summation amplifier. By this arrangement the limitations imposed on the application of scintillation counters because of the fluctuations of the dark current are eliminated. (Gmelin Inst.)

9542 DOUBLE PULSE RECOGNITION CIRCUIT. Larry Scott (to U. S. Atomic Energy Commission). U. S. Patent 3,167,654. Jan. 26, 1965.

A radiation detector output circuit is described which functions to suppress signals that are too closely spaced to be separately assimilated by subsequent counting circuitry. Unlike previous means for this purpose the invention does not identify concurrent signals by the amplitude of the directly combined pulses and thus does not reject valid signals which happen to have unusually large amplitude. Two detectors are used and pulses from both, produced by a single charged particle, are stretched in a special delay line circuit to a predetermined time period and applied to a coincidence circuit. If any portion of the two stretched pulses is concurrent in time, an output signal inactivates subsequent pulse counting circuitry. (AEC)

9543 A DEVICE FOR RECORDING GAMMA TOPOGRAMS. E. Yu. Elkind and V. L. Krivoshein. Russian Patent 162,896.

A device for recording gamma-topograms is described. The device contains a scintillation pickup, linear amplifier, single-channel amplitude analyzer, count rate meter, system for controlling the movement of the scintillation pickup, and a recording unit. To increase definition in the scintigrams and reduce the total scanning time for the automatic regulation of the scanning step, an electrical threshold relay circuit is set up in the device to transform electrical pulses fed from the count rate meter into command signals for the system which reduces the scanning step when the scintillation pickup passes over a section with a high accumulation of radioactivity. (auth)

Radiation Effects

9544 (AD-603229) EFFECTS OF NUCLEAR RADIATION ON FREQUENCY CONTROL DEVICES. Quarterly Report No. 6, December 1, 1963—February 29, 1964. Bernard Gerstein and Albert Fueyo (Admiral Corp., Chicago). Mar. 31, 1964. Contract DA-36-039-AMC-00002(E). 69p. $3.00(OTS)

Pre-irradiation, in-source, and post irradiation frequency and resistance measurements are reported for CR-19/U crystal units with construction variations. The radiation source used was the Admiral Corporation Co (60) Facility to a dose of 1×10^7 R. Twelve groups with distinctly different construction variations were evaluated. A marked difference was observed in the reaction of the group in which the synthetic quartz was used. Nickel-over-gold electrode plating appears superior. No apparent superiority is evident among bonding materials. Ribbon type support is inferior to the piano-wire technique. A method of increasing the gamma flux at the pulsed reactor by using polyethylene and cadmium is described. (auth)

9545 (AL-TDR-64-112) NUCLEAR EFFECTS PREDICTION TECHNIQUES FOR TELEMETRY. T. J. Klingen,

S. K. Misra, B. J. Stralser, and D. J. Welling (McDonnell Aircraft Corp., St. Louis). May 1964. Contract AF33(657)-11533. 116p. (AD-604335). $4.00(OTS)

A literature survey was performed to study various nuclear-effects prediction techniques. Circuit equations and a mathematical model were developed, which are used to predict the response of a simple circuit during and after exposure to nuclear radiation. If desired, a digital computer may be used as an aid in solutions. The approach uses circuital analysis rather than component analysis. An experimental program is outlined, which is intended to verify the prediction techniques involved. (auth)

9546 (REIC-36) THE EFFECT OF NUCLEAR RADIATION ON ELECTRONIC COMPONENTS, INCLUDING SEMICONDUCTORS. R. K. Thatcher, D. J. Hamman, W. E. Chapin, C. L. Hanks, and E. N. Wyler (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Oct. 1, 1964. Contract AF33(615)-1124. 232p. Dep.(mn); $6.00(cy), 5(mn) OTS.

A summary is presented of information accumulated within the past 3 years plus information previously reported in REIC Reports Nos. 1, 10, and 18. Component results are grouped as to family within each component class type. The presented results are intended to provide a basis for judging the merits of the parts when they are to be used in circuitry that will be exposed to a radiation environment. Some of the data can be considered as design oriented to the extent that they indicate radiation levels at which the parts would be expected to perform satisfactorily. (auth)

9547 RADIATION-RESISTANT EQUIPMENT—DESIGN DATA AND GUIDELINES. Alan Corneretto. Electron. Design, 12: 14p.(June 8, 1964).

Design data pertinent to the production of electronic circuits and equipment that can survive the radiation environments of weapons and propulsion systems are discussed. Electronic components and material properties are examined for behavior in an intense neutron and gamma radiation environment. The techniques available for designing hardened equipment to meet various system requirements are outlined, and examples of radiation-resistant circuits are given. Test programs used to ensure that equipment conforms to specified performance goals are discussed. (H.D.R.)

9548 DESIGNING AGAINST RADIATION. PART 2. Henning H. Lind Olesen (General Electric Co., Philadelphia). Electronics, 38: No. 1, 70-6(Jan. 11, 1965).

Information concerning the selection of electronic components and design of radiation-resistant electronic circuits for use in space is presented. The emphasis is placed on development of electronics that operate with minimum shielding. (J.R.D.)

9549 MULTIPLICATION IN SILICON p-n JUNCTIONS. John L. Moll (Technical Univ. of Denmark, Lundtofte). Phys. Rev., 137: A938-9(Feb. 1, 1965).

Multiplication values were measured in the collector junctions of silicon p-n-p and n-p-n transistors before and after bombardment by 10^{16} neutrons/cm^2. Within experimental error there was no change either in junction fields, as deduced from capacitance measurements, or in multiplication values in any of the transistors. The implication is that the electron and hole ionization rates did not change as a result of the addition of extra scattering centers. This result is in direct contradiction to observations of Lee et al. The most likely explanation for the discrepancy is erroneous determination of junction field by Lee et al. (auth)

9550 SOLAR CELL CHARACTERISTICS, DETERMINED AS FUNCTION OF ELECTRON IRRADIATION AND TEMPERATURE ON TABLE MOUNTAIN. John H. Martin (Johns Hopkins Univ., Silver Spring, Md.). 16p. (CONF-657-4)

From 4th Annual Photovoltaic Specialists Conference, Cleveland, June 1964.

Two experiments were undertaken to determine the effects of temperature and irradiation on silicon solar cells. The first experiment was confined to limited temperature variations, 10 to 90°C, and to only four integrated electron flux levels. Current versus voltage characteristics were determined by use of a Spectrosun solar simulator. The second of these experiments was conducted with the objective of obtaining an accurate indication of the effects of temperature and irradiation on solar cell performance in natural sunlight. (H.D.R.)

ISOTOPE TECHNOLOGY

General

Refer also to abstract 10677.

9551 PREPARATION AND APPLICATIONS OF ^{99m}Tc. Tamas Lengyel (Inst. for Isotopes, National Atomic Energy Commission, Budapest) and Gyorgy Somogyi. Magy. Kem. Lapja, 19: 428-32(Aug. 1964).

The preparation of ^{99m}Tc from MoO_3 by means of reactor-irradiation is described. The principal product is separated from the byproduct, ^{99}Mo, by means of anion-exchange techniques. Compounds labeled with ^{99m}Tc, when injected in venal blood, do not become absorbed rapidly in other tissues; on the other hand, owing to their relatively mild γ-radiation, can be administered with small risk. The activity of the injected compound can be conveniently measured with the aid of instruments equipped with scintillator heads. Blood tests on dogs were described. 14 references, including 2 Russian, 1 Japanese, 3 German, and 8 Western are given. (auth)

Industrial Applications

Refer also to abstracts 9446, 9447, 9472, and 10595.

9552 (EUR-1645.f) L'EMPLOI DES ISOTOPES RADIOACTIFS POUR DECELER LES FUITES DE GAZ. (Use of Radioactive Isotopes for Gaseous Leak Detection). M. Sales, F. Borelli (Società Italiana per il Gas), A. Bruna, and P. G. Caldera (Società Ricerche Impianti Nucleari, Milan). 1964. 54p. Dep.(mn).

A method of locating leaks in underground gas mains based on the use of ^{82}Br tagged methyl bromide is described. The method consists in injecting into the main a uniformly active gas mixture containing CH_3Br^{82}, and with a radiation detector finding the points where the presence of escaped radioactivity shows failures of the main. Full details of the technique are given together with the results obtained in many experiments carried out, in various experimental conditions, on mains put out of service. (auth)

9553 APPLICATION OF IONIZING RADIATION TO FRUIT PRODUCTS. P. Dupaigne. Ann. Nutr. Aliment, 17: B365-81(1963). (In French)

Studies made on the application of ionizing radiations to fruits and fruit products are summarized. Articles and general reviews giving data on fruits, studies on prolongation of the life of fruits with radiation, physiological and chemical effects of radiation on fruits, mutations induced by radiation, and radiation effects on fruit juice are compiled. 103 references. (J.S.R.)

9554 APPLICATION OF RADIOISOTOPES IN THE TEXTILE INDUSTRY. W.-J. Schmidt-Kuster and H. Mohrhauer. Atomwirtschaft, 9: 611-13(Dec. 1964). (In German)

The results of the IAEA Conference on the applications of isotopes in industry are discussed. Application possibilities present themselves at practically all stages from the manufacture of the raw textile material to the improvement of the finished fabric. In the case of raw materials the manufacture of some artificial fiber materials is possible by radiation induced polymerization. In addition the manufacture of textile raw materials can be rationalized and improved by the introduction of isotope measuring processes. In the spinning mill the most important problem is the checking of lubricating films distribution, e.g. the distribution of paraffin on yarn; this can be solved using radioactive indicators. Contactless surface weight measurement with the help of radiation measuring equipment and isotope sources is of particular significance in the manufacture of woven and knitted goods. The main bulk of application in the textile sphere is however concerned with improvement. While industrial application in this field is just beginning, research application is already wide ranging. (auth)

9555 EFFECTS OF IONIZING RADIATION ON THE BANANA. P. Dupaigne. Fruits (Paris), 19: 209-12 (1964). (In French)

A bibliographic review of studies made on the radiation preservation of bananas is presented. Studies still to be undertaken are indicated. (J.S.R.)

9556 THE MEASUREMENT OF FLOW OF LIQUIDS AND GASES USING RADIOACTIVE ISOTOPES. C. G. Clayton (Wantage Radiation Lab., Berks, Eng.). J. Brit. Nucl. Energy Soc., 3: 252-68(Oct. 1964).

Methods of measuring liquid and gas flow in turbulent motion using radioactive isotopes are reviewed. The principles, limitations, and performance of techniques based on both a constant rate and a sudden injection of radiotracer are discussed. Attention is drawn to differences in application to flow measurement in closed conduits and in open channels and streams. Radioisotopes in the form of sealed sources, can be used to produce ionization in a gas, which can also be used to measure gas flow. The continuous ionization method, which provides a means of measuring mass flow, was compared with the mean velocity method both of which were used as the basis of instruments for continuous gas flow measurement. (auth)

9557 WEAR MEASUREMENTS ON CYLINDER BUSHINGS BY MEANS OF THE RADIOISOTOPIC METHOD. Jozsef Fodor and Judit Ury (Inst. for Vehicle Development, Budapest). Magy. Tud. Akad. Muszaki Tud. Oszt. Kozlemen., 34: 247-53(1964). (In Hungarian)

The radioisotope method for measuring the wear of vehicle engine components has the advantage that the determinations may be carried while keeping the engine under continuous operation. Previous studies on the wear of cylinder rings were extended to the bushings. In order to reduce radiation danger to the personnel, activation in a reactor was used, fulfilling the requirement that the active component must have the same mechanical properties as the rest of the system. The surface was covered with Cd foil with the exception of two 10 × 170 mm strips which were activated for the measurements. Under the conditions used, the dose rate from the activated system was 20 mr/hr at 1.5 m around the cylinder. The measurements involved determination of the activity of wear products in the lubricating oil. The one-cylinder diesel engine was operated for repeated test periods of 6, 10, and 15 hr. The results revealed the existence of a 20-hour-long break in period; after 30 hours, the wear was very small. The wear due to startup tended to cover up the effects of extended running time. Similar tests with rings indicated that about 50% of the wear occurs during the first 3 hours of operation. (TTT)

9558 ABSORPTION-TYPE β-RAY THICKNESS GAUGE (UPA-10A). Toshio Takai and Shigeo Watanabe (Meidensha Electric Mfg. Co., Ltd., Japan). Meidensha Jiho, No. 54, 27-31(Apr. 1964). (In Japanese)

A satisfactory versatile, industrial β-ray thickness gauge (UPA-10A) was developed for the control of paper production. A single ionization chamber as the β detector is temperature- and humidity-sensitive, and it is very difficult to use in industry. These problems were overcome by housing, thermostatically, the ionization chamber, high resistors, orthogonal converter, and pre-amplifier. The gauge consists of a C-type frame containing a detector housing and β source (^{90}Sr), a bed with a mechanism for moving the frame, and a remote-control panel. It detects the differential of the thickness of a specimen from the standard material. In operating the thickness gauge, it was found that the room temperature, atmospheric pressure, and back-scattering of the β rays did not affect the indication of thickness. However, the net weight of paper is considerably influenced (5–10%) by the relative humidity (70–90%) of air, and the electrostatic charge on the paper interferes with the thickness indication. There are needs for the further study of the relation between the paper thickness and the air humidity, and for a suitable device for de-electronizing before the measurement of thickness. (NSA of Japan)

9559 HIGH ACCURACY FLUID DENSITY GAUGE USING GAMMA RADIATION. P. Tábor and L. Lakosi. Acta IMEKO (Intern. Messtech. Konf.), 1964, 427-37. (CONF-640902-4)

Measuring density to an accuracy of 10^{-3} to 10^{-4} g/cm^3 required in many technological processes can be achieved by gamma absorption equipment. A sensitive and high-stability gamma detector and an electronic amplifier unit were developed. The high-pressure argon-filled ionization chamber (130 atm) developed had a sensitivity of 10^{-8} A/r/hr and good long-term stability. The vibrating-condenser electrometer had a ±100 μv day-to-day stability. The measuring accuracy mentioned also involves severe requirements concerning most of the units of the measuring apparatus. For optimal design it was necessary to take into consideration and to analyze quantitatively all the parameters of the measuring system. General relations connecting the parameters of the system, the disturbing signals, and the measuring accuracy were developed which depend on the absorption law of the radiation (first approximation: narrow beam) and the characteristics of the detector, such as sensitivity, plateau slope, and temperature coefficient. Characteristic equations of the single chamber—voltage compensated system, and those of the double chamber—differential coupled system are discussed. The two systems were investigated in parallel to determine the influence of activity on the sensitivity of the measuring system, the influence of response time on the statistical fluctuations of the indication, the influence of temperature fluctuations of the process liquid on the required temperature compensation, and the influence of instability of the high voltage supply. Determination of the optimal parameters of the system was based on the equations and requirements of industrial applications as well as health physics considerations. Error sources were quantitatively evaluated through the whole measuring range. On this basis the measuring ranges, corresponding to various (10^{-3} to 10^{-4}) measuring accuracies were determined. More exact calculations are carried out, considering the geometrical arrangement and scattering (second approximation; wide beam). The results of the experimental investigations proved the degree of approximation reached by the calculations. (auth)

9560 DEVELOPMENT OF A TRITIUM SELF-LUMINOUS LIFE RAFT LIGHT SOURCE. Ernest B. McFadden, J. D. Garner, and R. A. Masler (Civil Aeromedical Research Inst., Oklahoma City). 15p. (CONF-522-3)

From Annual Meeting of the Aerospace Medical Assn., Miami, Fla., May 1964.

A self-luminous light source utilizing tritium gas, a radioactive isotope of hydrogen, and a zinc sulfide phosphor is described. The sources are primarily designed to provide survivors emerging from the ditched aircraft, or already in the water, with a visible identification of the location and attitude of the life raft and boarding stations. Two sizes of tritium light sources were designed and tested. Eight three-inch sources of 425 microlamberts each of brightness were fabricated for use on the periphery of a 25 man life raft. Two six-inch sources of 225 microlamberts each were fabricated for use at the boarding station. Special geometry of the sources allows visibility angles in excess of 180°. Emission of visible light is continuous and not dependent upon an external source of energy. Reduction in brightness is a function of the half life of tritium (12.6 years). The use of self-luminous safety devices utilizing tritium is approved by the Atomic Energy Commission and presents no radiation hazard to crew or passengers. (auth)

9561 HYDROGEN ^{35}S-SULPHIDE AS A RADIOMETRIC REAGENT FOR THE STUDY OF GELATIN COATINGS ON TEXTILE YARN. S. C. Ellis and J. H. Barrett (Wantage Research Lab., Berks, Eng.). Vienna, International Atomic Energy Agency, 1964, Preprint SM-55/2, 16p. (CONF-641001-44)

From Symposium on Radiochemical Methods of Analysis, Salzburg, Austria.

Thin coatings of size, frequently gelatin, are applied to multifilament yarns before weaving. The thickness and uniformity of these coatings is believed to control accidental snags occurring during weaving. A radiometric method for determining the amount and distribution of this surface coating was examined. Hydrogen (^{35}S)–sulfide is reacted with cupric ions, added to the gelatin, and the distribution of radiation from the ^{35}S subsequently determined. By using a gaseous reagent, disturbance of soluble films is avoided, and the maintenance of uniform concentration during reaction and subsequent removal of excess reagent facilitated. The reaction is carried out in a vacuum system at room temperature. Typical conditions are hydrogen sulfide at a partial pressure of 3 torr and water vapor at 15 torr. After a suitable reaction period the excess reagent is removed by pumping down to a good vacuum. Uptake of hydrogen sulfide by uncoated yarns was found to be small in the case of cellulose acetate and other synthetic fibers examined. Assay of the coating is achieved by direct counting of the β-particles emitted from the surface. (P.C.H.)

9562 THE USE OF GAMMA RADIATION FOR THE PRESERVATION OF SCALLOP MEAT. H. E. Power, D. I. Fraser, W. Neal, W. J. Dyer, C. H. Castell, H. C. Freeman, and D. R. Idler (Technological Research Lab., Halifax, N. S.). New York, American Inst. of Chemical Engineers, 1964, Preprint 33b, 26p, $0.50. (CONF-641201-9)

From American Institute of Chemical Engineers Annual Meeting, Boston.

Studies were made on the effects of sub-sterilization doses of gamma radiation on the storage life at 0°C of sea scallops (Placopecten magellanicus Gmelin) as well as the effect on certain chemical changes that take place during storage at 0°C. Bacterial counts in relation to the degree of spoilage as noted by odor and texture of the scallops were found to be low. Also, the glycogen content did not change in the frozen scallop muscle in 38 days. Scallops irradiated at 75,000, 150,000, and 300,000 Rads were indistinguishable in taste from the iced controls immediately after irradiation. However, irradiation levels above 150,000 Rads imparted a spongy, mushy texture that was found to be unacceptable. This condition was apparent immediately in the scallops irradiated at 400,000 and 800,000 Rads, and developed rapidly in samples irradiated at 150,000 and 300,000 Rads. Scallops subjected to 75,000 Rads maintained the characteristic firm, slightly rubbery scallop texture to over 30 days. Spoilage of the irradiated fish at different days is discussed. (P.C.H.)

9563 PASTEURIZATION OF FISHERY PRODUCTS WITH GAMMA RAYS FROM A COBALT-60 SOURCE. L. J. Ronsivalli (Technological Lab., Gloucester, Mass.). New York, American Inst. of Chemical Engineers, 1964, Preprint 33d, 30p, $0.50. (CONF-641201-7)

From American Institute of Chemical Engineers Annual Meeting, Boston.

Research was conducted on the radiopasteurization of fresh fish for the purpose of extending the refrigerated shelf life of these products. The results of studies thus far indicate that clam meats and haddock, cod, pollock, and ocean perch fillets can be held at 33 to 35°F in an acceptable condition for at least one month after treatment with low doses of gamma radiation (150–450 kiloRads). Suitable techniques for studying volatile carbonyl and sulfide compounds in clam meats and fish fillets were developed and changes in the concentrations of carbonyls and sulfides, caused by irradiation, storage, and cooking, were determined. At least twenty aldehydes, ketones, and sulfides were identified in the volatiles of clam meats. Data are given to show that radiopasteurization of haddock fillets has practical application even when the fish from which they were cut have been stored in ice for more than half their normal shelf life prior to irradiation. Experiments to determine the suitability of available plastic films as packaging materials for irradiated seafoods showed that films having a relatively low oxygen permeability are suitable and those having a relatively high oxygen permeability are unsuitable. The films tested (polyethylene, polypropylene, polyester, nylon-11, and others) were found to be resistant to bacterial penetration. They were also relatively free from pinholes and their seams were adequately strong. It was found that the bacterial numbers in fresh haddock fillets were reduced by at least 99% as a result of irradiation with 250,000 Rads. (P.C.H.)

Power Application

Refer also to abstracts 10009 and 10013.

9564 RADIOISOTOPE POWER SYSTEMS FOR MANNED SPACE STATIONS. Alan J. Streb (Martin Co., Baltimore). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-711, 31p. $1.00. (CONF-640901-3)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

Radioisotope power systems in the range of three to four kilowatts are considered for application to manned orbiting space stations. Isotope selection and availability, power conversion systems, and safety are considered for present station concepts. Systems using Po-210 or Pu-238 and employing the Brayton cycle are concluded to offer a number of advantages over the conventional photovoltaic system in this power range. (H.D.R.)

9565 THE RADIOISOTOPE-POWERED, BIMETALLIC-DISK ENGINE. Calvin C. Silverstein (Hittman Associates, Inc., Baltimore). 9p. (CONF-446-76)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

A pulse-type thermodynamic engine powered with a radioisotope heat source and employing a bimetallic disk as the energy conversion element is investigated. It is found that such an engine is technically feasible, and its principal design characteristics are evaluated. (auth)

Separation and Production

9566 (BLG-247) PRODUCTION DU Ca^{47} PAR CAPTURE (n,γ). (Production of ^{47}Ca by (n,γ) Capture). R. Constant and A. Francois (Centre d'Étude de l'Énergie Nucléaire, Brussels). Nov. 1963. 9p. Dep.(mn).

A study was made of the conditions for the production of ^{47}Ca by neutron irradiation of enriched calcium. The theoretical study was carried out by examining samples of various isotopic content and its incidence on the specific activity and on the contamination by ^{45}Ca. It is shown that the production of ^{47}Ca with sufficient specific activity and radiochemical purity requires the use of targets highly enriched in ^{46}Ca. (auth)

9567 (CONF-640606-3) THE COLUTRON, MARK II, ZERO DEFLECTION ISOTOPE SEPARATOR. Robert G. Matlock and Lars Waehlin (Colorado. Univ., Boulder). [nd]. Contract [AT(11-1)-506]. 4p. Dep.(mn); $1.00(cy), 1(mn) OTS.

From American Physical Society Summer Meeting, Denver.

The Colutron, Mark II, is a portable, low-intensity zero-deflection variable-dispersion isotope separator which uses a velocity or Wien Filter as the separating element. The ion source, focusing, velocity filter, collector, and scanner are described. (D.L.C.)

9568 (NP-14359) ISSLEDOVANIE NEKOTORYKH IZOTOPNYKH EFFEKTOV V TERMODINAMICHESKIKH SVOISTVAKH PROSTYKH ZHIDKOSTEI. (Investigation of Certain Isotope Effects on the Thermodynamic Properties of Simple Fluids (thesis)). V. N. Grigor'ev (Akademiya Nauk Ukr. S.S.R. Fiziko-Tekhnicheskii Institut). 1963. 146p. Dep.(mn).

In studies on molecular distillation of mercury isotopes, for a free path in the vapor equal to or less than 100 times the distance from the surface of the liquid to the condenser, the distribution coefficient was equal to the ratio of the square roots of the isotope masses. For mercury isotopes of different mass number, the lower limits of differences in saturated vapor pressure, ΔP/P, were 3×10^{-4} or less at −30°C and 1.3×10^{-4} or less at 200°C. Rayleigh distillation cannot be used for determining small ΔP/P values becuase of the significant kinetic effect on the isotope distribution coefficient at a low distillation rate. The only method of measuring ΔP/P for heavy elements is a fractionation method. In a nonpacked fractionating column operating at intermediate temperatures ΔP/P values of 4.7×10^{-4} for ^{82}Kr and ^{86}Kr at 120°C and of 10^{-4} for ^{130}Xe and ^{136}Xe at 165°C were found. The number of theoretical plates in the column was equal to the calculated value at low vapor rates. The HETP was 0.15 cm for a vapor rate of 0.2 cm/sec. The good agreement between experimental and calculated data makes it possible to use a nonpacked column for determining the self-diffusion coefficient of vapors. A simple system was developed for automatic temperature regulation with a precision better than 10^{-4}°C. For isotopes of neon, argon, krypton, and xenon of different mass numbers, the relation $\Delta P/P \sim m^{-4}$ was found at the boiling point under normal pressure. A systematic increase in the relative difference between experimental and theoretical values of ΔP/P for isotopes of the noble gases was observed with an increase in the element mass, which may indicate the existence of an unconsidered theory of the mechanism taking place at decreased ΔP/P values. The nonpacked column operating at low vapor rates at liquid hydrogen temperatures completely separated a ternary mixture of hydrogen isotopes. Densities were measured and volumes calculated for H_2-D_2 mixtures. At all temperatures and concentrations the volumes were positive, as was the case also for solutions of the liquefied gases argon−methane, argon−nitrogen, and others. A qualitative contradiction was observed between experimental and theoretical data on the volumes of mixtures in the hydrogen−deuterium system. (tr-auth)

9569 (ORNL-P-782) CONVERSION OF A CALUTRON INTO A 180° SECTOR SEPARATOR WITH 0.8 INHOMOGENEITY. T. W. Whitehead, Jr., W. K. Dagenhart, W. A. Bell, Jr., and L. O. Love (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 8p. (CONF-641110-2) Dep.(mn); $1.00(cy), 1(mn) OTS.

From Tennessee Academy of Science Meeting, Memphis.

The calutrons in the electromagnetic plant at Oak Ridge are described, and their use in the separation of Ca isotopes is discussed briefly. In order to increase the separation distance between the beams, the conversion of a calutron to a sector separator with circular iron shims to produce a high field inhomogeneity was studied. The problem of obtaining a precisely shaped magnetic field is discussed. (D.L.C.)

9570 COLUMN PACKING USED FOR ISOTOPIC SEPARATION. Yu. R. Akopov, I. G. Gverdtsiteli, V. A. Kaminskii, and G. L. Partsashavili. At. Energy. (USSR), 17: 380-4(Nov. 1964). (In Russian)

Requirements are formulated for the packings used for isotope separation in columns. The properties of various wire packings were studied, and the region of their use was determined. (tr-auth)

9571 ON THE DIFFERENTIAL MOBILITY OF LEAD ISOTOPES AND THE CHARACTER OF THE ADMIXED LEAD IN MONAZITES. L. V. Komlev, K. S. Ivanov, and V. G. Savonenkov. Geokhimiya, No. 12, 1228-39(Dec. 1964). (In Russian).

A strong enrichment in isotopes of admixed ordinary lead was established in easily mobile fractions of the lead of acid extracts from monazites. The amount of ordinary lead in them reached 44 to 91%. However with an increase in lead being extracted into sublimates and extracts, the role of radiogenic isotopes was intensified in it. In using archeian and recent correction lead to calculate the ratios of radiogenic lead isotopes in the extracts a distinct picture of a considerable enrichment of the extracts in uranium isotopes of lead in comparison with thorium isotopes was obtained. This was indicative of a considerable deficiency of thorium lead in surface zones of monazite alteration and agreed well with the often observed age underestimation in the ratio of ^{208}Pb to thorium. The admixed lead has the character of a later-supplied lead and possibly corresponds to the mobile lead of rocks. (auth)

9572 PROCESSING THE REACTOR-IRRADIATED KCl, FOR THE OBTENTION OF HIGH SPECIFIC ACTIVITY COMBINATIONS WITH ^{35}S. P. Bebesel, C. Chiotan, and C. Rentea. Rev. Chim. (Bucharest), 14: 599-600(Oct. 1963). (In Romanian)

The β-active ^{35}S with a half life of 87.1 days is the only S isotope suitable for use as a tracer. It may be prepared by the nuclear reaction ^{35}Cl(n,p)^{35}S. For the preparation of high-activity ^{35}S compounds KCl may be used because it is nonhygroscopic and the ^{42}K formed has a short half life. The H_2SO_4 or H_2SO_3 formed on the dissolution of the irradiated KCl target must be separated from the bulk of the KCl and from the traces of the simultaneously formed $H_3{}^{32}PO_4$. A column of Brookman type Al_2O_3, activated by the passage of HCl, was used to adsorb the ^{35}S + 1% of ^{32}P. The adsorptive capacity of the material was 0.17 mmole/g. A column containing 1 g of 100 to 200 mesh Al_2O_3 was used for treating 120 g of the irradiated KCl containing 7 C of ^{35}S. The adsorbed material was eluted with 1$\underline{M}$ NH_4OH. The acidified $(NH_4)_2{}^{35}SO_4$ was passed through a column of Amberlite IR-120 resin. The final product obtained represented a yield of 85 to 90% and had a specific activity of 40 to 50 mC/ml; it contained only traces of ^{32}P. Labeled $(NH_4)_2{}^{35}S_2O_8$ was also prepared by the usual anodic oxidation method. (TTT)

9573 SEPARATION OF LITHIUM ISOTOPES BY A CONTINUOUS COUNTER CURRENT ION EXCHANGE METHOD. V. I. Gorshkov, I. A. Kuznetsov, and G. M. Panchenkov (Moscow State Univ.). Zh. Fiz. Khim., 38: 2489-91(Oct. 1964). (In Russian)

A scheme is given for separation of Li isotopes by continuous countercurrent ion exchange. Coefficients of single-stage lithium isotope separation on sulfo-cationite KU-2 with 6 to 8% divinyl benzene were determined. For aqueous solution exchange α = 1.0010, in 60% methanol α = 1.0014 at flow rates through the cationite of 6 to 8 ml/hr. cm^2, for exchange from 0.4 to 0.9$\underline{N}$ solutions the theoretical plate height was 6 to 9 mm. (R.V.J.)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 8730, 9312, and 10130.

9574 (CERN-64-51) A DEFINITE INTEGRAL WITH MODIFIED BESSEL FUNCTIONS. K. S. Koelbig (European Organization for Nuclear Research, Geneva). Dec. 14, 1964. 33p. Dep.(mn).

Some properties of the function

$$U(s,r) = \int_0^\infty e^{-st} \frac{I_0(rt)\ K_0\ (t) - I_0(t)\ K_0\ (rt)}{K_0^2(t) + \pi^2 I_0^2(t)} \frac{dt}{t}$$

are discussed. Short tables are given for U(s,r) and for

$$W_0(s) = \int_0^\infty e^{-st} \frac{dt}{t[K_0^2(t) + \pi^2 I_0^2(t)]}$$

and

$$W_1(s) = \int_0^\infty e^{-st} \frac{I_0(t)}{K_0^2(t) + \pi^2 I_0^2(t)} \frac{dt}{t} .$$ (auth)

9575 (HW-SA-3762) ESTIMATING PARAMETERS OF COMPOUND DISTRIBUTIONS. Carl A. Bennett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 29, 1964. Contract AT(45-1)-1350. 14p. (CONF-641107-1). Dep.(mn); $1.00(cy), 1(mn) OTS.

From American Society for Quality Control 8th Annual Technical Conference of the Chemical Division, Gatlinburg, Tenn.

The problem of composite populations in statistical analysis of data is discussed. A treatment of composite populations is presented, in which it is assumed that the set of probability functions ϕ_α is finite and that the density function P [ϕ_α] is a step function. A chronological bibliography on composite distributions is included. (D.L.C.)

9576 (IFA-EC/7) NEKOTORYE REZUL'TATY OTNOSITEL'NO ALGEBRAICHESKIKH CHASTICHNO UPORYADOCHENNYKH SISTEM. (Some Results of Partially Ordered Algebraic Systems). Dragosh Vaida (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). Aug. 1964. 17p. Dep.(mn).

A class of partially ordered lattice groups permitting Jordan normalization was analyzed and general properties of such an algebraic group are discussed. Applications of algebraic partially ordered groups in ordered Banach algebra are considered. Absolutely isolated noncommutative structurally ordered sub-groups and absolutely isolated ideal lattice ordered f-rings are also discussed. (R.V.J.)

9577 (IPP-6/6) SUBROUTINES STORAGE OVERLAPPING. K. Hain and F. Hertweck (Institut für Plasmaphysik, G.m.b.H., Garching, Germany). Aug. 1963. 10p. Dep.(mn).

A method for minimizing the storage used by a computer program is presented. (auth)

9578 (JINR-P-1872) OTSENKI RESHENII LINEINYKH RAZNOSTNYKH I DIFFERENTSIAL'NYKH URAVNENII S PEREMENNYMI KOEFFITSIENTAMI. (Estimates of Solutions of Linear Difference and Differential Equations with Variable Coefficients). A. A. Korneichuk (Joint Inst. for Nuclear Research, Dubna, U.S.S.R.). 1964. 9p. Dep.(mn).

It is proved that for the linear difference and ordinary differential equations of order k, with variable coefficients that tend to constant limits sufficiently quickly, the same estimates of the solution in the infinite interval hold true as those for the limiting equations with the constant coefficients. (auth)

9579 (K-1614) THE SHARE ALGOL 60 TRANSLATOR FOR THE IBM 709/7090/7094. Marjorie P. Lietzke, ed. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Jan. 20, 1965. Contract W-7405-eng-26. 166p. Dep.; $5.00 (OTS).

The SHARE ALGOL 60 Translator is the result of a cooperative effort by the members of the SHARE ALGOL Project. The translator, which operates under the FORTRAN II version II monitor system on the IBM 709/7090/7094, consists of a SUPERVISOR and six phases each one of which performs a specific function in the translation process. A general introduction to the entire system is presented, as well as a detailed description of each phase. The descriptions included together with the program which is available from the SHARE Distribution Agency, make it possible for a programmer to operate, maintain, and if desired modify the translator. (auth)

9580 (LA-3106(Vol.II)) TABLES OF THE NUMBER OF BINARY DECOMPOSITIONS OF ALL EVEN NUMBERS 0 < 2n < 200,000 INTO PRIME NUMBERS AND LUCKY NUMBERS. M. L. Stein and P. R. Stein (Los Alamos Scientific Lab., N. Mex.). July 1964. Contract W-7405-eng-36. 424p. Dep.; $7.24(cy), 13(mn) OTS.

A table is presented of the number of possible binary decompositions of each even number 2n into the sum of two "lucky" numbers, for 0 < 2n < 200,000. Tables derived by performing various operations on the original table are also presented. (T.F.H.)

9581 (NYO-1480-5) STABILITY STUDIES FOR DIFFERENCE EQUATIONS: (I) NON-LINEAR STABILITY. (II) COUPLED SOUND AND HEAT FLOW. R. D. Richtmyer and K. W. Morton (New York Univ., New York. Atomic Energy Commission Computing and Applied Mathematics Center). Aug. 25, 1964. Contract AT(30-1)-1480. 44p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Several simple initial-value problems based on an equation of the form $(\partial/\partial t)u + (\partial/\partial x)(u^2/2) = \psi$, where ψ is a given function, are considered, and the stability of certain difference schemes for these problems is studied numerically. The leap-frog scheme (with and without a dissipative term), the Lax-Wendroff equation, and a semi-implicit 4-point scheme are compared. The effect of various boundary conditions at the right boundary (where the differential equation requires no boundary condition if n > 0) on stability is studied. The non-linear instability, when present, was isolated, in each case, by comparison with a calculation in which $(\partial/\partial x)(u^2/2)$ was replaced by $u_0(\partial/\partial x)u$, where u_0 is the exact solution of the non-linear equation (for the problems chosen, this was known analytically). As was expected, the leap-frog scheme showed non-linear instability under circumstances in which the linearized equation was either stable or weakly unstable, but it can be stabilized by the introduction of a dissipative term, which, being of the fourth order, does not decrease the order of accuracy. The Lax-Wendroff equation was stable and highly accurate in all cases. The 4-point scheme was stable, and a tentative explanation for this is given. The difference equations for coupled sound and heat flow, in which the latter is treated implicitly, are considered. The stability condition is $c\ \Delta t/\Delta x < 1$, where c is the isothermal sound speed. This seems somewhat paradoxical, for if the thermal conductivity is small, signals travel at practically the adiabatic sound speed $\sqrt{\gamma}\ c$, which is larger than c. For such problems, stability, as usually defined, is inadequate for an actual calculation, since it considers only the limit $\Delta t, \Delta x \to 0$. A practical stability criterion for such problems is proposed and is applied to the problem at hand, with complete success, as judged by numerical tests, which are also described. The criterion leads, in this problem, to a stability condition intermediate between $c\ \Delta t/\Delta x < 1$ and $\sqrt{\gamma}\ c\ \Delta t/\Delta x < 1$, depending on various parameters, including Δt (or Δx) itself. The condition is shown to be necessary (by the Fourier analysis) and sufficient (by the energy method). (auth)

9582 (TID-21390) LECTURES ON THEORY OF APPROXIMATION. Michael Golomb (Purdue Univ., Lafayette, Ind.). [1962]. Contract [W-31-109-eng-38]. 292p. Dep. (mn); $6.00(cy), 5(mn) OTS.

Lectures presented at Argonne National Lab., Ill.

A series of lectures dealing with the approximation of real or complex functions, principally functions of a single real variable, is presented. Several problems are given particular attention. Emphasis is laid on unifying principles and approaches to the theory via functional analysis. (T.F.H.)

9583 (UCRL-7920(Rev.I)) TABLES OF CALABRO KAPPA SQUARE STATISTIC. James L. Willows (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 1, 1964. Contract W-7405-eng-48. 63p. Dep.; $3.00(OTS).

The tables in this report present values of the K^2 (Kappa Square) statistic developed by Calabro (Reliability Principles and Practices, McGraw-Hill Book Company, New York, 1962). $K^2 = [(Z_\alpha - Z_\beta\sqrt{k})/(k-1)]^2$, where Z_α is the normal deviate corresponding to the producer's risk; Z_β is the normal deviate corresponding to the consumer's risk; and k = (lot tolerance fractional reliability deviation/acceptable reliability level). This statistic is useful in calculating test time for a given reliability and confidence level. (auth)

9584 (WAPD-T-1700) COMPUTER ENVIRONMENTAL CONTROL AND PROTECTION. J. M. Marsh and V. P. Scott (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 1964. Contract AT-11-1-GEN-14. 30p. (CONF-751-2). Dep.(mn); $2.00(cy), 1(mn) OTS.

From Joint Eastern and Western Simulation Council Meeting, Pittsburgh, June 1964.

The loss of computing capability would have serious effects on many technical programs. Hazards that may affect computer operation include fire, electrical failure, cooling air failure, water damage, and gases, foreign matter, or radioactive particles in the environmental air. Methods are outlined for protecting computers against these hazards. (C.H.)

9585 HILBERT SPACES OF TYPE S. Alexander Grossmann (New York Univ., New York). J. Math. Phys. (N. Y.), 6: 54-67(Jan. 1965).

Certain Hilbert spaces of generalized functions are examined. They contain the space of tempered distributions, are invariant with respect to the Fourier transformation, and contain functions that increase rapidly at infinity. (auth)

9586 SCALAR INVARIANTS OF A ROTATIONAL SYSTEM IN A LIE ALGEBRA. M. C. Pease (Stanford Research Inst., Menlo Park, Calif.). J. Math. Phys. (N. Y.), 6: 111-17(Jan. 1965).

Matrix equations of the form dW/dz = [S, W] are considered, where S is a matrix function of z that is embedded in a given Lie algebra L—i.e., it is a curve in L. If the initial condition on W is in L, then W describes a curve in L. If the Killing form is used as a metric on L, then the behavior of the system is a pure rotation about an axis that is a function of z. A set of scalar invariants of such a system is obtained. These invariants form a set of conservation laws that the system obeys regardless of the detailed behavior of S(z). If S describes a curve in some L_1, which is a semisimple subalgebra of the algebra L in which the whole system is embedded, then the initial condition can be split into two parts, one of which is in L_1 and generates a solution in L_1, the other in a subspace that is orthogonal to L_1 and that generates a curve that remains in the subspace. Conservation laws that apply separately to the two parts can thus be obtained. The results have application to quantum mechanics, since the density matrix obeys this type of equation. They also have application to coupled mode theory if the corresponding power density spectrum matrix is used instead of the vector matrix. (auth)

9587 FORMAL SOLUTION OF A NONHOMOGENEOUS DIFFERENTIAL EQUATION WITH A DOUBLE TRANSITION POINT. P. F. Jordan and P. E. Shelley (Martin Co., Baltimore). J. Math. Phys. (N. Y.), 6: 118-35(Jan. 1965).

A formal solution of a fairly general nonhomogeneous, linear, second-order differential equation with a large parameter and a double transition point is presented. This equation arises, for instance, in the quasilinear theory of pressurized membrane shells of revolution. The fact that the solution which is of foremost importance in practical applications converges at infinity makes it convenient to use a direct approach, avoiding any transcendental transformation. The solution is described by means of influence functions which arise from a formal inductive process. The more important influence functions are tabulated. The results of two approximate asymptotic procedures are compared with the exact solution. (auth)

9588 ON THE REDUCTION FORMULA OF FEINBERG AND PAIS. C. G. Bollini, J. J. Giambiagi, and A. González Domínguez (Facultad de Ciencias Exactas y Naturales, Buenos Aires). J. Math. Phys. (N. Y.), 6: 165-? (Jan. 1965).

Feinberg and Pais considered a reduction formula for the Fourier transform of functions which depend only on the hyperbolic distance. It is demonstrated that the formula is valid for any causal distribution and that it is actually an extension of the well-known Bochner Theorem on the Fourier transform of radial functions. (auth)

9589 THE THEORY OF LINEAR TRANSPORT COEFFICIENTS IN QUANTUM STATISTICS. Shi-kang Chen. Wu Li Hsueh Pao, 19: 456-65(1963).

The Kubo formula of transport coefficients was analyzed by the method of Van Hove in the theory of approach to equilibrium. The results of dynamical theory were obtained without using the assumption of random phase, and compared with the solution of Boltzmann equation. It is expected that the phase interference effect may be observed in the frequency-dependence phenomena of strongly interacting system. The macroscopic measurement of high-frequency linear transport process does not destroy this interference effect. (Sci. Abstr. China, Math. Phys. Sci., 2: No. 1, 1964)

9590 THREE-DIRECTIONAL EXPANSION OF GREEN FUNCTIONS AND δ FUNCTION. Pei-yu Hous. Wu Li Hsueh Pao, 20: 11-18(1964).

The explicit expressions of 1/R the bipolar expansion of $(R = r_1 + r_2 + r_3)$ and $\delta(\vec{R})$ in various regions $(r_3 \geq r_1 + r_2$, or $r_1 + r_2 \geq r_3 \geq |r_1 - r_2|$ etc) are developed. (1/R) is represented by $(1/2\pi^2)\int(e^{iK\cdot R}/K^2)\,d^3K = (1/2\pi^2)\int(e^{iK\cdot r_1}\ e^{iK\cdot r_2}\ e^{iK\cdot r_3}/K^2)\,d^3K$. The recurring rules and continuity of $\lambda j t_1, t_2, t_3$, the generalized Hobson expansion, and the bipolar expansion of (e^{-K_0R}/R) are also discussed. (TCO)

9591 THE APPLICATION OF METHODS OF STATISTICAL MECHANICS TO ELECTRODYNAMICS. Arthur Stanley Hobson. Thesis, Manhattan, Kan., Kansas State Univ., 1964. 102p.

Statistical mechanical methods, and in particular the Liouville equation, are applied to problems in classical electrodynamics. The problems examined are (1) one point charge with zero external field, (2) one point charge with arbitrary static external field, (3) N point charges with zero external field. In each case, the problem is to obtain the evolution equation for the point charges and then to investigate this equation. It is shown that for a system of charges and fields the Lorentz gauge action principle leads, by the usual methods of mechanics, to the Lorentz gauge Hamiltonian for the entire system of charges plus fields. The evolution equation is obtained by beginning with the above Hamiltonian, writing down Liouville's equation for the system of charges plus fields, treating the interaction of the electrons with their own fields as a perturbation in the Hamiltonian, retaining only terms of zero, first, and second order in the perturbation, assuming certain initial conditions on the field variables, and finally integrating Liouville's equation over all field variables. This results in an evolution equation for the reduced distribution function for the charges alone. The evolution equation may be interpreted as the Boltzmann equation for the motion of the charges, where the flow term arises from the unperturbed motion and the collision term arises from the interactions of the electrons with their own fields; these interactions may thus be thought of as collisions between the electrons and the field oscillators. The field initial conditions are found to imply that the initial self field is specified (with no statistical dispersion) to be the field of a stationary point charge. Renormalization consists of retaining all infinite quantities and combining them with the "bare mass" and "bare charge." Charge renormalization is required only in problem (2). No cut-off procedure is used. (A.G.W.)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstracts 9145, 9146, 10569, and 10570.

9592 (ASD-8-170(IV)) HOT WORKING EVALUATION OF REFRACTORY AND REACTIVE METALS. Fourth Interim Report, April 1–June 30, 1964. John Bonchak (Universal-Cyclops Steel Corp., Bridgeville, Penna.). July 1964. Contract AF33(657)-11270. 55p. (AD-603779) $3.00(OTS).

The tendency of refractory and reactive metals to be contaminated in the InFab argon atmosphere was investigated. The results of exposures for various times, temperatures, and argon purity levels were evaluated by microhardness traverses, metallographic examination, chemical analyses and bend tests. With due consideration to extraneous variables and accuracy of the test methods, the results have been appraised. (auth)

9593 (BM-RI-6578) EVALUATION OF ELECTROWON TUNGSTEN POWDER. G. H. Keith, B. D. Jones, and E. A. Rowe (Bureau of Mines. Reno Metallurgy Research Center, Nev.). June 1964. 13p. Free(Bureau of Mines).

An evaluation of electrowon tungsten powder was made by comparing its characteristics with conventional hydrogen-reduced tungsten powder. Electrowon tungsten powder was investigated with respect to particle size and shape, apparent density, flow rate, compressibility, green strength, and sintering characteristics. In addition, its chemical purity, absolute density, and purification by melting were determined. Significant findings were higher flow rates and better compressibility than hydrogen-reduced tungsten powder. However, the large particle size peculiar to the electrowinning process effectively prevented conventional sintering to a high-density material. The possibility of producing high-density material, using a new technique of hot swaging sheathed sintered-tungsten compacts, was demonstrated by the achievement of densities of 92 percent of theoretical. (auth)

9594 (CEA-R-2431) EXAMEN AU MICROSCOPE ELECTRONIQUE EN TRANSMISSION DE BULLES DE GAZ RARE DANS LES METAUX: ANALYSE DES EFFETS DE CONTRASTE OBSERVES. (Transmission Electron Microscope Examination of Rare-Gas Bubbles in Metals: Analysis of Observed Contrast Effects). Viviane Levy (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Oct. 1964. 19p. Dep. (mn).

Metallic samples containing rare gas bubbles have been examined by transmission electron microscopy. The different features of the contrast patterns of the bubbles have been explained by the dynamical theory of contrast, assuming that the bubble behaves as a hole in the metal. Experimental results are in good agreement with the theory. (auth)

9595 (CEA-R-2575) ESSAIS TECHNOLOGIQUES ET MISE AU POINT DE L'ELEMENT COMBUSTIBLE EDF 2. (Development and Testing of the EDF 2 Reactor Fuel Element). Paul Delpeyroux (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay) and Robert Furhmann (Société Industrielle de Combustible Nucléaire, Paris). Dep.(mn).

A review is presented of the work which has been necessary for defining the EDF2 fuel element. The EDF2 reactor characteristics and the preliminary choice of parameters which made it possible to draw up a draft plan for the fuel element are given. The following research is considered: 1) Uranium studies: tests on the passage into the β phase of an internal crown of a tube, bending of the tube under the effect of a localized force, welding of the end-pellets and testing for leaks. 2) Can studies: conditions of production and leakproof testing of the can, resistance of the fins to creep due to the effect of the gas flow. 3) Studies of the extremities of the element: creep under compression and welding of the plugs to the can. 4) Cartridge studies: determination of the characteristics of the can-fuel fixing grooves and of the canning conditions, verification of the resistance of the fuel element to thermal cycling, and determination of the temperature drop at the can-fuel interface. 5) Studies of the whole assembly: the graphite jacket, the support, the cartridge vibrations, and the behavior of the centering devices in a gas current. The outcome of this research is the defining of the plan of the element, the production process, and the production specifications. The validity of all these out-of-pile tests will be confirmed by the in-pile tests already under way and by irradiation of the elements in the EDF2 reactor itself. In conclusion the program is given for improving the fuel element and for defining the fuel element for the second charge. (auth)

9596 (COO-1319-18) A STUDY OF THE MECHANISM OF STRESS CORROSION CRACKING IN THE IRON–NICKEL–CHROMIUM ALLOY SYSTEM. Quarterly Report, June 17, 1964–September 16, 1964. F. H. Beck, M. G. Fontana, and J. P. Hirth (Ohio State Univ. Research Foundation, Columbus). Oct. 6, 1964. Contract AT(11-1)-1319. 14p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The fabrication and properties of wires containing various amounts of chromium, iron, and nickel along with small amounts of other constituents are discussed. A recirculating autoclave system for studying stress corrosion cracking by chloride- and hydroxide-containing environments is described. (N.W.R.)

9597 (DMIC-193) TUNGSTEN RESEARCH AND DEVELOPMENT REVIEW, 1960–1962. J. L. Ratliff, W. A. Gibeaut, and H. R. Ogden (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Oct. 23, 1963. Contract AF33(616)-7747. 59p. (AD-425474) $1.50(OTS).

Summaries are presented of 104 separate studies in 79 research programs sponsored by the Government for the development of tungsten. These programs cover nine areas: preparation of metal, consolidation, primary and secondary working, joining, fabrication and performance of rocket nozzles, oxidation and other high-temperature reactions, protective coatings, properties, and physical metallurgy. The 79 research programs are also listed. (D.L.C.)

9598 (DMIC-Memo-197) ELECTRODEPOSITED, ELECTROLESS, AND ANODIZED COATINGS ON BERYLLIUM. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). Sept. 1, 1964. 11p. (AD-609132) $1.00(OTS).

Information is presented on the prefinishing and coating of Be with nonmetallic and metallic materials. The methods covered include electrodeposition, electroless plating, and anodizing. A bibliography is included. (D.L.C.)

9599 (EUR-2166.e) HIGH-TEMPERATURE VAPOR PRESSURE STUDIES OF UO_2 BY THE EFFUSION METHOD. R. W. Ohse (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). 1964. 58p. Dep.(mn).

A high-temperature effusion investigation of the vapor pressure of uranium dioxide under high vacuum is presented over the temperature range from 2200 to 2800°K. The theory, experiment, and applicability of the Knudsen effusion method and the Langmuir rate of evaporation method are described in detail. The construction of effusion cells with particular attention to questions of compatibility, cosine distribution, molecular flow and Clausing factor, temperature distribution, and temperature measurement is discussed. The black body hole readings are corrected for both the transmissivity of interposed windows and the cavity temperature of the effusion cell. The spectral emissivity of tungsten is measured as a function of temperature by the application of Wien's radiation law in the whole range under consideration. The spectral emissivity at 0.65 microns decreases from 0.44 at 2300°K to 0.416 at 2850°K. The mathematical treatment on behalf of gas kinetic considerations and the thermodynamic treatment according to the second and third law method of the effusion measurements are outlined. X-ray diffraction studies and micrographic and radiometric methods are applied to investigate the compatibility of W with UO_2, the congruent vaporization of UO_2, and the condensation coefficient and invariance of the measurements. The vapor pressure of UO_2 is given as log p (mm) = 12.4264 − 3.3183 10^4/T in the high-temperature range from 2200 to 2800°K. The latent heat of sublimation ΔH^0_{298} = 148.6 kcal/mole is determined by the application of the third law method. Log p was calculated on behalf of ΔH^0_{298} and the free energy function for gaseous and solid UO_2 for the lower range from 1500 to 2000°K. The least square analysis for this range yields the equation log p(mm) = 11.556 − 3.1209 10^4/T and indicates a small difference in slope from the higher range. (auth)

9600 (EURAEC-1209) STUDY OF BASE METAL TO BE USED IN RESEARCH ON BRITTLE FRACTURE OF LARGE WELDED ASSEMBLIES. Quarterly Report No. 2. (Institut de Recherches de la Siderurgie, St.-Germain-Enlaye, France). Oct. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 031-64-5-GEEF(RD). 5p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Expansion and quenchability tests on Super Elso steel were reported. For the expansion tests, samples were taken near the upper surface, ¼ of the way through, at the core, and near the lower surface of the test bar. The curves obtained were completely superposable. In the quenching tests, the quenchability was slightly better for the core sample. (J.S.R.)

9601 (GEAP-3470) NON-DESTRUCTIVE TESTING OF LOW-COBALT STAINLESS STEEL FUEL CLADDING FOR CORE II, N. S. SAVANNAH. N. S. SAVANNAH FUEL DESIGN AND DEVELOPMENT PROGRAM. G. L. Boshears and E. L. Dunn (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). June 22, 1960. Contract AT(04-3)-189. 34p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Nondestructive (ultrasonic, eddy current, and fluorescent penetrant) and destructive tests were carried out on type 304 stainless steel tubing with low Co content (less than 50 ppm). The results show that the standards and techniques currently used will detect defects in excess of 10% of the wall thickness. Small laminar inclusions and voids were found in all the tubing; they did not appreciably affect the tube strength except under fatigue loading conditions. Eddy current techniques were found to be limited in their application to re-drawn tubing with small reductions. (D.L.C.)

9602 (HW-81601) CERAMICS RESEARCH AND DEVELOPMENT OPERATION. Quarterly Report, April–June 1964. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Contract AT(45-1)-1350. 115p. Dep.; $4.00(cy), 2(mn) OTS.

Progress is reported in the following sections: ceramics research, fuel development, and fuel testing and analysis. Separate abstracts are prepared for each section. (N.W.R.)

For abstracts of individual sections see: 9603, 10512, and 10513.

9603 (HW-81601(p.2.1-35)) CERAMICS RESEARCH. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Preliminary results indicate that of the four known borides of plutonium (PuB, PuB_2, PuB_4, PuB_6), the diboride is the predominant phase below 900°C. Samples of β-Pu_2O_3 were prepared by carbon reduction of PuO_2 by vacuum reaction sintering followed by inert gas arc-melting. Carbon free β-Pu_2O_3 was also prepared by heating $PuO_{1.8}$ with an excess of plutonium hydride in vacuum. Stability experiments show β-Pu_2O_3 to be more oxidation resistant than PuO_{2-x}. ThN was prepared by arc melting thorium under one atmosphere of nitrogen. X-ray diffraction and metallographic analyses of a PuO_2–SiO_2 glass revealed little solid solubility between PuO_2 and SiO_2. X-ray diffraction analyses show that PuO_{2-x} present as an impurity phase (10 vol%) in PuN, does not react with the PuN at 1500°C in nitrogen. PuO_2–SS cermets were pneumatically impacted to densities of 96–99% of theoretical. The cermet density decreased by only 2.18% after 409 hr in vacuum at 900°C. A PuN–50 vol% ZrN pressed pellet was held at 2000°C in vacuum for 5½ hr. The PuN volatilized prior to any detectable reaction with the ZrN. Clad cermet disks containing β-Pu_2O_3–50 vol% W, PuN–50 vol% W, and PuO_2–45 vol% (80 Ni/20 Cr) were prepared by pneumatic impaction. No reactions between PuN and graphite were detected visually or by x-ray diffraction after heating PuN in a graphite holder for 1 hr at 1727°C in nitrogen. A method of analyzing plutonium bearing fuel materials for water release at temperatures approaching in-reactor conditions was developed. PuO_2 was explosively melted by passing a high current pulse through a direct resistance heated sample. Metallographic examination of UO_2 pellets melted by direct induction heating in a dried Ar–8% H atmosphere revealed only single phase, nearly stoichiometric oxide. Initial measurements in a high pressure furnace indicate that the electrical resistivity of UO_2 near its melting point is about 10^{-3} ohm-cm. Using specially prepared nuclear emulsions, the distribution of plutonium in UO_2–PuO_2 was studied on a micron scale. X-ray diffraction analyses of previously discharged PuO_2 and PuN specimens were completed. Two irradiation test capsules containing UN–20 wt% PuN were discharged from the MTR after attaining approximate average burnups of 2.5 × 10^{20} fissions/cm^3 (~ 9,000 Mwd/ton) and 5 × 10^{20} fissions/cm^3 (~ 18,000 Mwd/ton). Examination of the lower exposure capsule is in progress. Postirradiation examination of US irradiated to ~ 3.3 × 10^{20} fissions/cm^3 revealed a 3.8% fission gas release and the presence of an unidentified phase with gross bubble formation. The lattice expansion of PuC appeared to be approaching saturation after 975 days of alpha self-damage at room temperature while that of Pu_2C_3 continued after 583 days. Solid fission products were transferred from an irradiated sample of UO_2 to an unirradiated one along a potential gradient. Preliminary radiochemical data show a concentration of cesium and strontium in uranium inclusions formed during high temperature irradiations of UO_2. Radiochemical analysis, using new microdrilling techniques, of irradiated UO_2 fuel elements confirms previous results of fission product migration and verifies migration of plutonium. (auth)

9604 (IS-900(Sect.M)) METALLURGY DIVISION. (Ames Lab., Ames, Iowa). 125p.

Progress is reported in metal preparation, purification, and related studies. Results of studies concerning phase equilibria and thermodynamic properties of metals, behavior of metals and alloys in plastic deformation, solid state properties and alloy theory, metal separations, and metallography are included. (J.R.D.)

9605 (LA-3173-MS) THE ALTERNATING CURRENT ELECTROETCHING OF PLUTONIUM. Kaye A. Johnson (Los Alamos Scientific Lab., N. Mex.). Oct. 2, 1964. Contract W-7405-eng-36. 11p. Dep.; $1.00(OTS).

The equipment and procedures used in the alternating current electrolytic etching of plutonium metallographic samples are described. Examples are given which pertain to low-purity delta plutonium alloys subjected to various degrees of cold rolling and in different conditions of homogeneity, low-purity alpha plutonium in the cast and rolled conditions, and high-purity alpha plutonium that had transformed directly from the liquid state to the alpha phase under very high pressure. (auth)

9606 (LA-DC-6712) PLUTONIUM FUELS. J. A. Leary, comp. (Los Alamos Scientific Lab., N. Mex.). Oct. 20, 1964. Contract W-7405-eng-36. 7p. (CONF-641111-2) Dep.(mn); $1.00(cy), 1(mn) OTS.

From US-Japan Information Exchange Meeting on Ceramic Nuclear Fuels 19th High Temperature Fuels Committee Meeting, Canoga Park, Calif.

Information is presented on the particle size distribution of the PuO_2 prepared from oxalate and on the sintering of PuO_2 in CO_2 and argon. The preparation of PuN by heating of partially hydrided Pu in N_2 is discussed, and the decomposition pressure of PuN is given. Electrical resistivities of arc-cast UC at 50 to 900°C are tabulated. The preparation of homogeneous Ce–Co–Pu alloys is described. Some emf measurements of a molten salt cell containing Pu are reported. (D.L.C.)

9607 (ML-TDR-64-70) PROCEDURE FOR EVALUATION OF COATED REFRACTORY ALLOYS. M. A. Levinstein and J. D. Marble (General Electric Co., Evendale, Ohio). July 1962. Contract AF33(616)-8154. 287p. (AD-604738) $6.00(OTS)

Procedures for the evaluation of coated molybdenum and niobium alloys were investigated. A simple corrugated specimen was designed to determine the applicability of current coatings to a fabricated structure. Coated specimens were oxidation tested at 2500°F up to 10 hours and sectioned for metallographic examination and hardness determination. Dynamic oxidation tests were conducted using a gas-fired flame tunnel and a plasma test stand. Effects of the coatings and elevated temperature exposure on basic metal properties were established by combined stress, fatigue, and tensile tests. Coatings from six sources were investigated on the program. Based on the results obtained, recommendations are made for the standardization of the applicability specimen and combined stress testing along with other mechanical tests for the evaluation of coated refractory metals. (auth)

9608 (ML-TDR-64-81) APPLICATION AND EVALUATION OF REINFORCED REFRACTORY CERAMIC COATINGS. Charles Kallup, Jr., Samuel Sklarew, and Stanley V. Castner (Marquardt Corp., Van Nuys, Calif.). May 14, 1962. Contract AF33(616)-8209. 173p. (AD-604423) $5.00 (OTS).

Metal reinforced refractory ceramic coating systems have been developed to successfully withstand temperatures in excess of 4000°F while providing insulative values for the supporting substructure. Eighty coating compositions were formulated and thermally evaluated in the plus 4000°F range. Refractory coating of model nose cones and leading edges has been accomplished by utilizing a vibratory casting technique and the feasibility of this approach has been demonstrated. Twelve small scale leading edge models and six small scale nose cone models were coated in addition to one 500 square inch leading edge and one 500 square inch nose cone model. Thicknesses ranged from 0.3 to 0.75 inch. Mechanical data and thermophysical properties of an advanced coating system were obtained. An up-to-date bibliography of reinforced refractory ceramic systems and allied subjects is included. (auth)

9609 (ML-TDR-64-83) METAL–CERAMIC STRUCTURAL COMPOSITE MATERIALS. J. W. Vogan and J. L. Trumbull (Boeing Co., Seattle). Aug. 1962. Contract AF33(616)-7815. 185p. (AD-604685) $5.00(OTS)

Thoria and magnesia bodies were developed for use in metal-ceramic composites. Good thermal shock resistance was imparted to these bodies through control of particle size distribution. Magnesia was sintered at 2200°F and thoria at 2800°F. Plasma and oxyacetylene torch tests developed to evaluate these materials and similar zirconia composites showed that magnesia and zirconia can be used to 4600°F and thoria to 5400°F. A magnesia foam backing was developed for use with composites to reduce heat transfer to the substructure with a minimum gain in overall weight. Platinum and Inconel honeycomb were selected for use as a metal reinforcement for these bodies to produce material systems suitable for use in high heat flux applications such as the nose cap of a glide re-entry vehicle. Leading-edge configuration samples prepared from magnesia with Inconel honeycomb reinforcements were fabricated. (auth)

9610 (UJV-960/64) THE PREPARATION OF UO_2 BY THE REDUCTION OF U_3O_8 IN HYDROGEN AND THE EFFECT OF HEAT TREATMENT OF U_3O_8 ON THE PROPERTIES OF UO_2. P. Imris (Československá Akademie Věd. Ustav Jaderného Vyzkumu, Řež). [1964]. 35p. Dep.(mn)

The study describes the preparation of UO_2 with a specific surface of 0.1 to 6 m^2/g by the reduction of U_3O_8 in H_2. The properties of UO_2 were determined relative to the conditions of calcination of U_3O_8(610°C to 1000°C) prepared from ammonium diuranate–ADU–and $UO_3 \cdot 0.8H_2O$. Thermogravimetric curves of the reduction of U_3O_8 in H_2 and the reduction temperature of UO_2 which changes with the properties of U_3O_8 from 520°C to 670°C are presented. The results of measurement of the specific surface of U_3O_8 and of UO_2 and the temperature difference ΔT, the lattice constant of UO_2, the O/U ratio, and the particle size of UO_2 and of U_3O_8 are discussed. In the case of UO_2, prepared from U_3O_8 calcinated at 700°C, sintering of pellet at a temperature of 1600°C and a pressure of 2.5 t/cm^2 yielded material with a density of 96% theoretical. For the purpose of characterization of UO_2, the use is suggested of the coefficient β, according to which UO_2 may be classified into two groups, namely UO_2 prepared from U_3O_8 and UO_2 prepared by direct reduction of the ADU in H_2. The coefficient is calculated from the relation $\beta = \Delta T/S$ where S is the specific surface of UO_2 and ΔT the difference in temperatures of the first and second oxidation stage of UO_2. (auth)

9611 (UNC-5102) STUDY OF URANIUM–PLUTONIUM MONOXIDES. Progress Report, August 1, 1964–October 31, 1964. D. Stahl, A. Strasser (United Nuclear Corp. Development Div., White Plains, N. Y.); J. Andersen, and K. Taylor (Carborundum Co., Niagara Falls, N. Y.). Dec. 28, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3305. 42p. (EURAEC-1287) Dep.(mn); $2.00(cy), 1(mn) OTS.

Mixtures of up to 45 vol % of carbon rich Pu(OC) in βPu_2O_3 and (UPu)(OC) in $(UPu)O_2$-type phase were produced. Only small amounts were produced when no carbon was present. Experiments designed to produce a high melting binary PuO were performed. Equipment was set up and checked out for the water corrosion tests and for the oxygen-to-metal ratio and oxygen in water analyses. (auth)

9612 (AI-Trans-68) THE EFFECT OF Mg TRACES ON RESISTIVITY CHANGES IN THE HARDENING OF Al–Zn ALLOYS. G. Bartsch. Translated by Anthony Cornell (Atomics International, Div. of North American Aviation, Inc., Canoga Park, Calif.), from Acta Met., 12: 270-2(1964). 5p. Dep.(mn); $1.10(fs), $0.80(mf) JCL.

The effect of Mg additions on the electric resistivity of Al–Zn alloys during their age-hardening is discussed. It is shown that the effect can not be explained only by the interaction of Mg atoms with vacancies. An attempt is made to calculate the activation energies for formation of vacancies and for their interaction with Mg atoms. (D.L.C)

9613 (ANL-Trans-148) APPLICATION OF PERMEABLE POROUS CERAMICS FOR THE EXPERIMENTAL STUDY OF MASS TRANSFER PHENOMENA. B. I. Fedorov and Z. P. Shul'man. Translated by Elmar K. Wilip (Argonne National Lab., Ill.), from Inzh.-Fiz. Zh., Akad. Nauk Belorussk. SSR, 4: No. 2, 99-102(Feb. 1961). 6p. Dep.(mn); $1.00(cy), 1(mn) OTS; $1.10(fs), $0.80(mf) JCL.

A new material of the permeable porous ceramic type is offered which is suitable for the manufacture of experimental solids to be used in the experimental investigation of the phenomena of heat and mass transfer. Results of an investigation of the porous structure of this material are presented and an analysis is made of factors affecting its physico-mechanical properties. Recommendations are given for the manufacture of experimental solids. (auth)

9614 (LA-tr-64-32) PROCESS FOR COATING PIECES OF GRAPHITE OR THE LIKE AND PRODUCTS THUS OBTAINED. Lucien Robert Guichet and George Jacques Gotoghian. Translated by C. P. Kempter and

Gretchen R. Riese (Los Alamos Scientific Lab., N. Mex.), from French Patent 918,872, Dec. 23, 1963. Filed Dec. 17, 1962. 4p. Dep.(mn); $1.10(fs), $0.80(mf) JCL.

A method is given for obtaining graphite pieces which are coated for protection against both temperatures >1800°K and thermal shocks and which are particularly suited for use as rocket nozzles. The method comprises forming an intermediate adherent layer before depositing on the graphite a refractory material such as W, Mo, carbide, etc. The intermediate layer material is a mixture of the upper coating material with one or more of the group Ru, Rh, Pd, Os, Ir, and Pt. The advantages of the intermediate layer are good wetting of the graphite, rapid diffusion into the graphite, and an expansion coefficient intermediate between those of graphite and the coating material. (D.L.C.)

9615 PREPARATION OF HIGH-PURITY TANTALUM. O. P. Kolcin and I. K. Berlin. At. Energ. (USSR), 17: 400-5 (Nov. 1964). (In Russian)

Results are presented of studies of the conditions of refining tantalum during its preparation by the carbo-thermal method. The introduction of a large number of impurities in the reduction process was studied. Investigations showed that the carbo-thermal method of reduction of tantalum by subsequent sintering is one of the most reasonable methods for obtaining tantalum of high purity in powder form as well as in the form of compact metal, suitable for pressure working. (tr-auth)

9616 THE PREPARATION OF HIGH-PURITY RHENIUM SINGLE CRYSTALS. R. R. Soden, G. F. Brennert, and E. Buehler (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Electrochem. Soc., 112: 77-9(Jan. 1965).

Rhenium single crystals were prepared by electron beam float zone melting with resistance ratios (R273°K/R4.2°K) exceeding 30,000. In one crystal a ratio in excess of 55,000 was obtained. It appears that purification occurs both by selective vaporization and zone refining. (auth)

9617 REFRACTORY METAL ALLOYS IN SHEET FORM: AVAILABILITY, PROPERTIES, AND FABRICATION. T. E. Tietz (United Metallurgical Corp., Berkeley, Calif.) and R. A. Perkins. J. Spacecraft Rockets, 1: 225-34(May-June 1964).

Availability of Nb, Mo, Ta, and W commercial alloys is discussed, giving maximum sizes of sheet produced at thicknesses of 0.060, 0.030, 0.010, and 0.002 in. The principal alloys of interest for aerospace applications are characterized in terms of composition, size availability, and cost. The current level of quality and activities to improve quality are considered. Tables and graphs are presented of the typical mechanical properties of these materials. Tensile strength and stress-rupture properties are emphasized. Current status in production-shop forming of these alloys is reviewed. General types of parts produced and the forming practices used are discussed. Problems in production forming, such as brittle fracture, delamination, and dimensional tolerances, are mentioned. (M.J.T.)

9618 PREPARATION OF THORIUM METAL FROM THE OXIDE. James B. Knighton, Alleppey V. Hariharan, Robert K. Steunenberg, and Wesley H. Hauschildt (to U. S. Atomic Energy Commission). U. S. Patent 3,164,462. Jan. 5, 1965.

A process is described for producing Th metal from ThO_2 dissolved in molten 90 $\underline{M}$% $MgCl_2$−10 $\underline{M}$% MgF_2 by reduction with a Mg−Zn alloy containing 10 to 15% by weight of Mg and separation of the Th-containing alloy from the salt mixture. The weight ratio of ThO_2 : flux may amount up to 0.2; an inert atmosphere and a temperature between 825 and 875°C are used. (AEC)

Corrosion

Refer also to abstract 9125.

9619 (AMRA-TR-64-33) ACTION OF SODIUM CITRATE AND SODIUM BORATE ON THE POLARIZATION CHARACTERISTICS OF A URANIUM−STEEL COUPLE. Milton Levy and Philip Wong (Army Materials Research Agency, Watertown Arsenal, Mass.). Oct. 1964. 18p. (AD-608343) $0.50(OTS).

The action of sodium citrate and sodium borate in aqueous media on the polarization characteristics of uranium and steel was studied. The effect of citrate and borate concentration on these polarization characteristics was also studied. Steady-state corrosion currents developed by the uranium-steel couple were measured using zero-resistance ammeter circuitry, and polarization measurements were made using galvanostatic techniques. Sodium citrate and sodium borate were classified as either accelerator or inhibitor, dependent upon concentration. (auth)

9620 (BMI-1700) DEVELOPMENT OF NIOBIUM ALLOYS RESISTANT TO SUPERHEATED STEAM. Robert D. Koester, John A. De Mastry, Warren E. Berry, Arthur A. Bauer, and Frank A. Rough (Battelle Memorial Inst., Columbus, Ohio). Nov. 11, 1964. Work Performed under United States Euratom Joint Research and Development Program. Contract W-7405-eng-92. 44p. (EURAEC-1285) Dep.(mn); $2.00(cy), 1(mn) OTS.

Niobium-base alloys containing additions of 18 to 24 at. % titanium, 12 to 18 at. % vanadium, and 9 to 12 at. % chromium were prepared by arc melting and evaluated for corrosion resistance in the cold-worked condition. Alloys containing greater than 9 at. % chromium could not be cold rolled because of a $NbCr_2$ precipitate in the grain boundaries. The niobium−21 at. % titanium−12 at. % vanadium−9 at. % chromium alloy was found to have excellent corrosion resistance to attack by 540°C deoxygenated steam, having a total weight gain of 465 mg per dm^2 for 10,000 hr of exposure. The resistance to steam attack at 650 and 705°C appears to be adequate to withstand reactor temperature transients. There was no evidence of stress corrosion in 540°C steam or in steam to which chloride ions had been added. Loop tests at GE-APED indicated that the niobium−21 at. % titanium−12 at. % vanadium−9 at. % chromium alloy does not have satisfactory corrosion resistance to BWR superheater steam (20 ppm oxygen and 2.5 ppm hydrogen) at 566°C. The 540°C short-time tensile properties were excellent, the alloy processing a yield strength of 150,000 psi and an ultimate tensile strength of 170,000 psi. Recrystallization occurs in 1 hr at 1150 ± 10°C. (auth)

9621 (DP-906) MICROPROBE STUDY OF ZIRCALOY CORROSION FILMS. Kurt F. J. Heinrich (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1964. Contract AT(07-2)-1. 44p. Dep.; $2.00(OTS).

The primary object of this study was to determine the potential usefulness of the electron probe analyzer as a tool for the investigation and elucidation of problems in the corrosion of zirconium alloys, particularly Zircaloy-2. The general applicability of the probe to corrosion studies was demonstrated. Techniques were developed for the preparation and study of corroded zirconium alloy specimens. Previously unknown characteristics of the distribution of the component elements were revealed in Zircaloy-2 specimens and other zirconium alloys which had been subjected to various heat treatments. Data were also obtained on the composition and distribution of alloy elements in the fundamental corrosion layers. The possible significance of these findings is discussed in the light of current theories on corrosion mechanisms in zirconium alloys. (auth)

9622 (NASA-CR-54200) STUDIES OF ALKALI METAL CORROSION ON MATERIALS FOR ADVANCED SPACE POWER SYSTEMS. Quarterly Progress Report No. 1 for Quarter Ending September 26, 1964. R. W. Harrison (General Electric Co. Missile and Space Div., Cincinnati). Contract NAS 3-6012. 32p.

A capsule program is being developed to examine the influence of stress on the corrosion behavior of D-43 alloy in potassium at 2000 to 2200°F and to investigate corrosion mass transfer effects in a stainless steel−niobium alloy-potassium system. Stress calculations for the design of the D-43 alloy capsule were completed and the capsule design was initiated. Design of the strain measurement and other auxiliary equipment was completed. Evaluation of types 321 and 316 stainless steel and niobium-1% zirconium alloy sheet was initiated. (N.W.R.)

9623 (NP-14632) CAVITATION DAMAGE CORRELATIONS FOR VARIOUS FLUID-MATERIAL COMBINATIONS. Technical Report No. 14. Frederick G. Hammitt, M. John Robinson, Clarence A. Siebert, and Fazil A. Aydinmakine (Michigan. Univ., Ann Arbor. Coll. of Engineering). Oct. 1964. 113p.

Cavitation damage data on stainless steel, refractory materials, carbon steel, aluminum, plexiglas, and a series of copper and nickel alloys of varying heat-treats in water and mercury, are presented. An attempt to correlate this data with material properties, degree of cavitation, and velocity effects shows that a single material property is not sufficient. Rather, a suitable grouping of material properties remains to be determined. Velocity effects are shown and explained in relation to changes in local flow conditions. Pressure profiles for the various cavitation conditions, including three pressure tap locations on the surface of the test specimens, are also shown and related to the damage. (auth)

9624 (SCNC-270) OXIDATION RESISTANCE OF MIXED CARBIDES. Final Report. H. Shapiro and R. Powers (Sylvania-Corning Nuclear Corp., Bayside, N. Y.). Mar. 1959. Contract AT(30-1)-Gen-366. 22p. Dep.(mn); $2.00(cy), 1(mn) OTS.

This report deals with oxidation resistance of mixed carbides, based mostly on silicon carbide as the main component, and with cemented carbides of various compositions. Most of the corrosion tests were made at temperatures varying from 1400–1650°C, and concerned various mixtures of carbides made in this laboratory, as well as tests on commercially available specimens for comparison purposes. Most of the specimens under test were not completely dense, and the results are therefore not necessarily conclusive. The tests, however, reveal that the addition of NbC, VC, or ZrC to SiC decreases the corrosion resistance above 1400°C, whereas the addition of TiC, TaC, or CrC in amounts of less than 10% to SiC-base gives very little, if any, improvement in oxidation resistance, at least up to 1650°C. (auth)

9625 (WAPD-TM-411) HYDROGEN ABSORPTION IN ZIRCALOY DURING AQUEOUS CORROSION, EFFECT OF ENVIRONMENT. E. Hillner (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Nov. 1964. Contract AT(11-1)-Gen-14. 43p. Dep.; $2.00(OTS).

An interpretive literature survey, supplemented with more recent laboratory evaluations, was made of the effects of various environmental factors on the aqueous corrosion and hydrogen absorption characteristics of Zircaloy. Relatively small quantities of dissolved oxygen have been shown to affect a substantial decrease in hydrogen pickup although the oxidation kinetics are little affected. Extensive quantities of dissolved hydrogen are required to produce a noticeable increase in hydrogen pickup without adversely affecting the corrosion process. A mechanism for hydrogen incorporation into the oxide during normal corrosion has been postulated, and the specific effects of oxygen and hydrogen in the environment on hydrogen pickup have been explained on the basis of the perturbations imposed upon the normal situation. (auth)

9626 ANTICORROSION EFFECT OF PHOSPHORIC ACID IN THE ALUMINUM CLADDING OF FUEL PLATES. Katsuichi Nakamura (Kinki Univ., Japan). Genshiryoku Kogyo, 10: No. 6, 33-7(June 1964). (In Japanese)

Phosphoric acid was found to be effective in the corrosion protection of the aluminum cladding of U–Al fuel plates. The Al surface (UTR-B type reactor) was observed for corrosion after 119 hours of operation. No corrosion was found when 50 ppm of phosphoric acid was added to the moderator water. In order to determine the corrosion mechanism, a corrosion hole on the fuel surface was observed by microscopic methods. (NSA of Japan)

9627 MATERIALS FOR MHD DUCTS. W. Rummel (Siemens-Schuckertwerke AG, Erlangen, Ger.). 6p. (CONF-640701-80)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Testing of materials for magnetohydrodynamic (MHD) ducts is reported. The results of MHD jet tests show that the refractory oxides are superior to other materials. Materials such as graphite and TiC suffered heavy weight losses caused by scaling. The materials tested include ZrO_2, SiC, BN, graphite, TiB_2, and TiC. (J.R.D.)

9628 COMPATIBILITY OF SOME REFRACTORY MATERIALS WITH CAESIUM VAPOUR. G. Arthur (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). 11p. (CONF-640701-77)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Tests were conducted to determine the reactions of BN, graphite, SiC, Al_2O_3, HfO_2, ZrO_2, W, Ta, and Mo with high-temperature Cs. Results showed that ZrO_2, Al_2O_3, and HfO_2 are suitable for use in magnetoplasmadynamic ducts with Cs at 1800°C. BN was not altered by Cs at this temperature but was evaporated. Mo and W were unaffected by heating in Cs at 1800°C, while Ta was embrittled. (J.R.D.)

Fabrication

Refer also to abstracts 10584 and 10597.

9629 (AD-608818) WELDING OF REFRACTORY METALS. Final Report. L. M. Bianchi, W. A. McNeish, and F. D. Seaman (Universal-Cyclops Steel Corp., Bridgeville, Penna.). July 1964. Contract NOw-63-0043-c. 243p. $6.00(OTS).

A study is reported of the effects of welding variables on refractory metals. The degree and magnitude of control of the variables necessary for the improvement of production welds in refractory metals is indicated. The flexibility of InFab as a large inert atmosphere chamber suitable for welding refractory metals was evaluated. The ability of a welder to accomplish out-of-position manual welds in InFab was demonstrated. A limited investigation indicated improved resistance welds may be produced by inert atmosphere protection. (auth)

9630 (CEA-R-2579) ELABORATION DES TUBES D'URANIUM METALLIQUE. (Preparation of Metallic Uranium Tubes). Georges Lerouge and Jacques Decours (France. Commissariat à Énergie Atomique. Centre d'Études Nucléaires, Saclay). Aug. 1964. 39p. Dep.(mn).

The production furnace is an induction-heated vacuum furnace having a capacity now of 250 kg. Previously the crucible was heated by the inductor, the mold being outside the inductor. The tubes thus produced contained cavities, the alloy structure was fine; this was cold-mold casting. Now the top of the molds are pre-heated; this is the so-called hot-mold casting. This method has the advantage of eliminating the cavities but leads to a less fine microstructure. The alloy used for the 18 × 40 mm and 23 × 43 mm tubes is U–Mo (1.1 per cent). Since the molds are now heated at the top, the solidification of the metal is very slow in this zone leading to a pronounced γ grain, whereas towards the base the faster cooling leads to a smaller γ grain. The γ structure depends essentially on the solidification rate and on the time spent in this zone. In order to obtain a fine and homogeneous grain along the whole length of the tube, a controlled cooling treatment is effected. It consists in heating the uranium tubes in the γ place and then in cooling them at a rate of between 20 and 50°C/mm down to 400°C. The 77 × 95 mm and 54 × 70 mm annular elements are now being produced for research purposes. Their preparation is similar to that of 18 × 40 mm and 23 × 43 mm elements. The 77 × 95 mm tubes are made from U–Cr alloy (0.1 per cent); because of their size, their preparation is carried out in 600 mm diameter furnaces. (auth)

9631 (CEA-R-2580) FILAGE ET ETIRAGE DU ZIRCALOY 2 REALISATION DES TUBES DE FORCE POUR EL 4. (Extrusion and Drawing of Zircaloy 2. Production of Pressure Tubes for EL4). Jean Thevenet and Jean

Buffet (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). Aug. 1964. 25p. Dep.(mn).

The physical, mechanical, and chemical properties of Zircaloy-2 are given, as far as the transformation of this alloy is concerned. After a few general remarks concerning the extrusion and coextrusion, including a comparison of the deformation resistance of canning metals and of Zircaloy-2, the following points are considered. (1) the difficulties occurring because of the use of this alloy: atmosphere protection, adjustment on to the machine tools, low thermal conductivity–economy of the metal (price); (2) the factors affecting the quality of the extruded products; extrusion under a copper can and under lubrifying glass, fine grain structure, temperature homogeneity, working temperature. The transformation cycle ("550 kg ingot–preliminary shape for drawing of EL4 tubes (112 × 120 L 12 m)" is described in detail (extrusion or forging of the $\phi = 340$ ingot into $\phi = 220$ billets, cutting into lengths and hot drilling at $\phi = 125$, fixing into a copper can, and rough extrusion). The main difficulties of drawing are due to seizing of the tools and to the necessity of protecting the alloy from the atmosphere during annealings. A brief description is given of drawing out on a short mandrel, on a long mandrel, of laminating on a reducing machine, and of the carrying out of an annealing, as well as the production of EL4 tubes ($\phi = 107 \times 113$ L 430 m) by drawing out shapes having a size of 112 × 120 on long mandrels. It is concluded that it is possible by extrusion and drawing to produce Zircaloy-2 tubes similar to those which may be obtained normally using stainless steel. (auth)

9632 (DP-860(Vol.II)) STAINLESS STEEL INFORMATION MANUAL FOR THE SAVANNAH RIVER PLANT. VOLUME II. FABRICATION. W. C. Rion, Jr., comp. (Du Pont de Nemours (E. I.) & Co. Engineering Dept., Wilmington, Del.). July 1964. Contract AT(07-2)-1. 219p. Dep.; $4.00 (OTS).

Information is presented on the various fabrication methods (welding, brazing, soldering, thermal cutting, machining, etc.) used for stainless steel. Heat treatment, testing and inspection, mill products, etc., are also discussed. (D.L.C.)

9633 (EURAEC-1106) WELDING OF VERY THICK STEELS. Quarterly Report No. 11, April 1–June 30, 1964. (Ghent. Rijksuniversiteit and Soudometal, S. A., Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 042-61-9RDB. 228p. Dep.(mn); $6.00(cy), 4(mn) OTS.

Work on the execution of local and semi-global tests was completed, and the determination of the global properties of 100-mm thick welded joints was continued. Local tests were devoted to measuring the effectiveness of certain relaxation treatments on the filler metals, to carrying out a certain number of electron microfractographic examinations of Charpy V impact strength specimens taken from tensothermally embrittled and embrittled-restored metals, and to measuring the influence of automatic welding parameters on the properties of deposited metals. Semiglobal tests were devoted to determining the dispersion affecting the Robertson isothermal test and to discover the tensile properties of manual automatic welded specimens with faults. The global tests consisted of Robertson isothermal tests on specimens fractured during welding in the transformation zones. (N.W.R.)

9634 (EURAEC-1166) ELECTRO-SLAG WELDINGS OF REACTOR STEELS. Technical Quarterly Report No. 12, April 1–June 30, 1964. (Schweisstechnische Lehr- und Versuchsanstalt, Duisburg, Germany). July 23, 1964. Work Performed under United States–Euratom Joint Research and Development Program. 96p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Techniques and equipment for welding thick ASTM A302B steel and chromium–molybdenum steel are evaluated. Preliminary experiments for starting and closing a circular seam on a reactor vessel are described. Results show that a totally closed circular seam can be successfully welded. The properties of welding wires and fillers for the steels are given. X-ray examinations of the welds and welded joints are analyzed. (N.W.R.)

9635 (HW-SA-3754) UTILIZATION OF PNEUMATIC IMPACTION FOR MATERIAL FABRICATION AND DEVELOPMENT. K. Drumheller (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 16, 1964. Contract AT(45-1)-1350. 5p. (CONF-641106-1). Dep.(mn); $1.00(cy), 1(mn) OTS.

From American Society of Metals Meeting, Richland, Wash.

A pneumatic impaction process for densification of ceramics, fabrication of complex shapes, and the creation of new materials is described. The effects of ultrahigh pressure and ultrashort time in diffusion type bonding, as compared to moderate times, temperatures, and pressures are discussed. Advantages such as the ability to combine normally incompatible materials, prevent grain growth during fabrication, and fabricate composites directly to shape are discussed. Applications to ceramic densification, cermet and composite fabrication, materials development, and materials joining are described. (auth)

9636 (NMI-9700-24) FINAL REPORT ON DEVELOPMENT OF DIES FOR EXTRUSION OF COMPLEX SHAPES OF STEEL AND REFRACTORY ALLOYS. J. G. Hunt, J. L. Klein, and J. M. Siergiej (Nuclear Metals. Div. of Textron Inc., West Concord, Mass.). Nov. 25, 1964. Contract AF-33(657)-8798. 133p. (ML-TDR-64-295; AD-608497)

The utility of massive ceramic dies for the precision high temperature extrusion of complex shapes of refractory metal alloys has been demonstrated. Precision extrusion of shaped structural steels through ceramic coated dies was gained by refinement and close control of extrusion parameters. Refractory ceramics of high compression strength like ZrO_2 or TiC were found capable of extruding TZM molybdenum alloy at 3700°F and 75 tsi producing 2.0 by 1.3 by 0.250 inch Tee sections in lengths up to at least fourteen feet with dimensional runout of less than three mils and surface smoothness of 63 rms. Ceramic coated dies, like Al_2O_3-coated tool steel, were found capable of extruding 4340 alloy steel at 2300°F and about 50 tsi, producing 2.0 by 1.5 by 0.062 inch Tee sections in lengths up to at least forty feet with dimensional runout of less than four mils and surface smoothness of 125 rms. The performance of massive ceramic dies in TZM extrusion indicates that massive ceramic dies would produce steel extrusions superior to those obtained with ceramic-coated steel dies. (auth)

9637 (NMI-TJ-13) LUBRICATION PROBLEMS IN FABRICATION OF NUCLEAR REACTOR METALS. Paul Loewenstein (Nuclear Metals. Div. of Textron Inc., West Concord, Mass.). [1955]. 12p.

Several examples are given of lubrication problems in the hot- and cold-working of reactor metals. The metals discussed include U, Th, Be, and Zr. (D.L.C.)

9638 (RFP-478) COATING BERYLLIUM WITH ELECTROLESS NICKEL. W. H. Roberts (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Dec. 29, 1964. Contract AT(29-1)-1106. 23p. Dep.; $1.00(OTS)

Electroless nickel may be deposited successfully from an acidic solution onto small beryllium shapes. The substrate must be thoroughly cleaned, deoxidized, and activated, and then covered with a thin zincate immersion coating. The nickel alloy deposit contains almost 7.5% phosphorus. The deposit exhibits uniform coverage even on complex beryllium surfaces. The rate of deposition can be controlled with relative ease by regulation of plating solution variables—temperature, pH, composition, and application time. (auth)

9639 VAPOR-DEPOSITED TUNGSTEN COATINGS ON GRAPHITE. Vernon A. Nieberlein (Army Missile Command, Redstone Arsenal, Ala.). Am. Ceram. Soc. Bull., 44: 14-17(Jan. 1965).

Unless a graphite with controlled thermal expansion is chosen for a substrate, vapor-deposited tungsten is highly prone to cracking. An investigation was undertaken to determine what effect, if any, the plating parameters had on the tendency of the deposit to crack. Deposition temperature, H_2/WF_6 ratio, and gas velocity were varied and the hardness, grain size, and tendency of the deposit to crack were related to these variables. (auth)

9640 FABRICATION OF THORIUM DIOXIDE FUEL. II. EFFECT OF THE POWDER PROPERTY AND SINTERING CONDITION ON THE FUEL DENSITY. Hideo Kinoshita and Shigeo Aoki (Furukawa Electric Co., Ltd., (Apr. 1964). (In Japenese)

The relationship between the properties of thorium dioxide powder and of thorium dioxide pellets obtained from the powder was studied. Optimum conditions of pressing and sintering the powder are discussed. It was concluded that when thorium dioxide is prepared from thorium oxalate, the fine powder of oxalate precipitated at low temperature is recommended. The density of a sintered pellet increased with increasing temperature and pressure, but in powder having good sintering properties 1500°C was sufficient and very high pressure was not required. The sintering time did not influence the properties considerably. The densities were compared among the pellets sintered in hydrogen, argon, and vacuum. The highest density was obtained in hydrogen. (NSA of Japan)

Properties and Structure

Refer also to abstract 9348.

9641 (AAEC/TM-271) THE HIGH-TEMPERATURE BeO PHASE— A REVIEW. M. J. Bannister (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Nov. 1964. 9p. Dep.(mn)

A survey is given of the literature on the high temperature phase transformation in BeO. Topics covered are the transformation temperature, the latent heat of transformation, the crystal structure of the high temperature phase, and stabilization at temperatures below the transformation temperature. It is concluded that stabilization by other compounds is unlikely to be achieved. (auth)

9642 (AD-442878) PHYSICAL METALLURGY OF TUNGSTEN AND TUNGSTEN BASE ALLOYS. Sixth Quarterly Progress Report, November 1, 1963–January 31, 1964. H. G. Sell, G. W. King, R. H. Schnitzel, and N. F. Cerulli (Westinghouse Electric Corp. Lamp Div., Bloomfield, N. J.). Feb. 15, 1964. Contract AF33(657)-8247. 34p.

The effects of void formation and strain rate on the tensile properties of high-purity powder-metallurgy tungsten was investigated as a function of temperature (1000 to 2400°C). Comparison is made with results obtained earlier on a W–1% ThO_2 alloy. Also evaluated were the effects of heat treating and quenching temperature on the tensile properties of carbon doped pure and W–0.25% Ta single crystals from 300 to 1200°C. In addition, strain aging type experiments were carried out to measure the precipitation hardening contribution to strengthening. Also investigated was the reaction of ThO_2 with carbon; the reaction products were identified to be ThC and ThC_2. (auth)

9643 (AD-602640) ORDERED MAGNETISM IN SOLIDS. Annual Summary Report. S. Shtrikman and D. Treves (Weizmann Inst. of Science, Rehovoth, Israel). Jan. 1, 1963. Contract AF61(052)-654. 13p. $1.00(OTS).

A summary is given of studies of the magnetic structures of various solids by means of static magnetic measurements, and vhf, microwave, and Mössbauer spectroscopy. (auth)

9644 (AD-603067) THE USE OF STRAIN SOFTENING TO IMPROVE THE PROPERTIES OF REFRACTORY METALS. Quarterly Progress Report No. 2, March 1–May 31, 1964. E. J. Ripling and S. Zager (Materials Research Lab., Inc., Richton Park, Ill.). Contract NOw-64-0247-c. 18p. $1.00(OTS).

Work has been continuing to determine the flexing procedure that will result in the maximum lowering of transition temperature. Unfortunately, the scatter in NDT for the most recently obtained heat of Mo–0.5 Ti alloy is so broad (approximately 80°F) that it has been difficult to evaluate property changes. Attempts will be made to reduce the scatter range by improving the surface finish using mechanical and electrochemical finishes. In spite of the excessive scatter, a general behavior pattern appears to be developing: Flexing does not cause a uniform lowering of the transition temperature as one might expect, for example, with a continuous decrease in interstitial content. Instead, the bend-angle vs. testing temperature curve is similar to the as-received one down to the vicinity of the NDT temperature (possibly with a lower shelf height). At still lower temperatures, a ductility recovery occurs causing a hump or double transition. The cause for this is still not known, but it appears that the length of the slip element is decreased by flexing. (auth)

9645 (AD-604867) EFFECTS OF COMPOSITION VARIATIONS ON THE PROPERTIES OF 5Ni–Cr–Mo–V STEEL. S. J. Manganello and L. F. Porter (United States Steel Corp., Monroeville, Penna.). [July 1964]. 46p. $2.00(OTS).

Four composition modifications of a 0.10 percent carbon 5Ni–Cr–Mo–V steel and three modifications of a 0.15 percent carbon 5Ni–Cr–Mo–V steel were investigated. Among the 0.10 percent carbon steels, the standard 5Ni–Cr–Mo–V steel and a 0.9 Mn, 0.04 Si modification exhibited the best combination of yield strength (140 to 150 ksi) and notch toughness (80 to 120 ft-lb at 0°F). Severe embrittlement occurred when the chromium content was increased to 1.25 percent and a general loss in toughness resulted when aluminum was eliminated. Increasing the carbon content of the 5Ni–Cr–Mo–V steel from 0.10 percent to 0.15 percent increased the yield strength (after appropriate tempering) from the 130/150 ksi range to the 150/165 ksi range, but decreased the notch toughness at 0°F to the 50 to 90 ft-lb range. At the higher carbon content, the notch toughness was somewhat improved when the manganese and silicon contents were reduced. The results indicate that the standard 0.10 percent carbon 5Ni–Cr–Mo–V steel has the best composition for a steel capable of developing a yield strength of 140 to 150 ksi and exceptional notch toughness. A 0.15 percent carbon 5Ni–Cr–Mo–V steel also exhibits good notch toughness at yield strengths of 150 to 165 ksi. (auth)

9646 (AD-604872) EFFECT OF CARBON ON THE HARDENABILITY AND MECHANICAL PROPERTIES OF 5Ni–Cr–Mo–V STEEL. S. J. Manganello and L. F. Porter (United States Steel Corp., Monroeville, Penna.). July 1, 1964. Contract NObs-88540. 50p. $2.00(OTS).

Seven 5Ni–Cr–Mo–V steels containing 0.05 to 0.27 percent carbon were evaluated to establish the carbon-ordering range for the 5Ni–Cr–Mo–V steel as an HY-130/150 steel and to determine the potential of the 5Ni–Cr–Mo–V steel as an HY-180/210 steel. The results showed that an average yield strength of about 140 ksi should be obtained in ½-inch-thick water-quenched production plates at a carbon content of about 0.045 percent, but that a minimum carbon content of about 0.085 percent should be specified to obtain similar properties at the midthickness of 4-inch-thick water-quenched plates. Therefore, an ordering range of 0.08 to 0.13 percent carbon is recommended for the 5Ni–Cr–Mo–V steel to ensure the desired strength, toughness, and weldability for an HY-130/150 steel. In the tempering range 900 to 1200°F, none of the steels investigated exhibited a yield strength of 180 ksi. (auth)

9647 (AD-604876) THE EFFECTS OF LOW-TEMPERATURE TEMPERING ON THE PROPERTIES OF 0.25 PERCENT CARBON Ni–Cr–Mo STEELS. S. J. Manganello and L. F. Porter (United States Steel Corp., Monroeville, Penna.). July 1, 1964. 44p. $1.00(OTS).

Five selected steels (3Ni–Cr–Mo–Nb, 3Ni–Cr–Mo, 5Ni–Cr–Mo, and two 5Ni–Cr–Mo–V steels) containing 0.22 to 0.27 percent carbon were evaluated after tempering at appropriate temperatures to determine their suitability as HY-180/210 steels. The results indicated generally that the five steels had adequate hardenability for 4-inch-thick plates and that yield strengths of about 185 ksi were attained at a carbon content of 0.25 percent carbon when the steels were tempered at temperatures in the range 400 to 1000°F. In addition, none of the steels was significantly embrittled by tempering. At a yield strength of 185 ksi, none of the steels met the tentative minimum toughness (50 ft-lb at 0°F) for an HY-180/210 base metal. However, the 3Ni–Cr–Mo–Nb steel and the 0.22C 5Ni–Cr–Mo–V steel appear capable of meeting the toughness requirement at a yield strength of about 182 ksi in $\frac{1}{2}$-inch-thick plates and of about 175 ksi in 4-inch-thick plates. (auth)

9648 (AD-608737) X-RAY DIFFRACTION STUDY OF IMPERFECTIONS IN RHENIUM. Technical Report No. 10. C. N. J. Wagner and E. N. Aqua (Yale Univ., New Haven. Hammond Metallurgical Lab.). July 1964. Contract Nonr-609(43). 27p. $2.00(OTS).

An analysis was made of the broadening of the powder pattern peaks from rhenium powders exhibiting different strength properties in the green compacts and from deformed rhenium sintered sheet. The primary source of the line broadening was the small particle size of the crystallites; broadening attributed to lattice distortions was small or negligible. Evidence was found for growth faults on the (002) planes in the samples studied, and most significantly in the powder of the low green strength briquet (one fault every 100 (002) planes) and in the deformed sheet rhenium. (auth)

9649 (AD-608738) AN X-RAY DIFFRACTION STUDY ON THE EFFECT OF RHENIUM ON THE OCCURRENCE OF FAULTING IN REFRACTORY ALLOYS. Technical Report No. 11. E. N. Aqua and C. N. J. Wagner (Yale Univ., New Haven). Sept. 1964. Contract NONR 609(43). 34p. $4.00 (OTS).

The bcc alloys of the terminal solid solutions of rhenium in niobium, tantalum, and tungsten were investigated by several x-ray and metallographic techniques. Three different methods (Fourier analysis, integral breadth determination, and variance analysis) are utilized for the description of the x-ray diffraction powder pattern peaks. The anisotropic particle size broadening for the cold worked Ta–10 at. % Re, W–20 at. % Re, and Nb–Re alloys (containing less than 11 at. % Re) is interpreted as evidence for stacking and/or twin faults on the (112) planes in the bcc structures. The addition of rhenium increased the fault density in the tungsten alloy, but not in the tantalum and niobium alloys. The addition of greater than 11 at. % Re to niobium raises the ductile-brittle transition temperature to room temperature. These alloys fractured (when hammered) by cleavage on the {001} planes. The analysis of the shapes of the diffraction profiles from powders of these brittle alloys (produced by hammering) indicated that the line broadening was due predominantly to platelets bounded by cube planes. The isomorphous Ta–10 at. % Re alloy is also brittle, exhibiting {001} cleavage. Fractographic examination of the cleavage facets revealed the characteristic cleavage step and river patterns, indicating plastic deformation occurring prior to fracture. Microcracks and deformation twins associated with the crack formation were observed on sections transverse to the cleavage surface. (auth)

9650 (AERE-R-4685) THERMAL CONDUCTIVITY OF A BOROSILICATE GLASS SUITABLE FOR FISSION PRODUCT WASTES. D. B. Auty and J. R. Grover (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Statistical Appendix by B. E. Cooper. Dec. 1964. 24p. Dep.; $0.70(BIS); 3s. 6d.(HMSO).

The thermal conductivity of a borosilicate glass incorporating mock fission product wastes has been measured by a radial heat flow method and found to vary from 0.00247 cal/cm-sec-°C at 200°C to 0.00281 cal/cm-sec-°C at 550°C. The temperature drop across the glass/steel interface is small and hardly significant when calculating the axial temperature in cylinders of glass in storage. (auth)

9651 (AMRA-TR-64-28) DEVELOPMENT OF A STRUCTURAL URANIUM ALLOY. Jacob Greenspan and F. J. Rizzitano (Army Materials Research Agency, Watertown Arsenal, Mass.). Sept. 1964. 10p. (AD-609554). $1.00(OTS).

A uranium alloy is described, and data are given on mechanical behavior and on how it is affected by certain variations in alloy content and thermal history. The range in property values thus presented was considerable. The work described is associated with possible applications of depleted uranium for structural purposes. (auth)

9652 (CEA-R-2568) PROPRIETES DES ALLIAGES URANIUM–MOLYBDENE DE FAIBLES TENEURS UTILISABLES COMME MATERIAUX COMBUSTIBLES. (Properties of Uranium–Molybdenum Alloys of Low [Mo] Content Utilizable as Fuel Materials). Jeanne Lehmann and Jacques Decours (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Aug. 1964. 43p. Dep.(mn).

Metallurgical properties are given of uranium–molybdenum alloys containing 0.5 to 3 per cent of molybdenum. Since some of these alloys are used in EDF power reactors, the operating conditions imposed on nuclear fuels are given briefly: maximum temperature, temperature gradient, and external pressure. The structural properties of the alloys are considered in correlation with the phase transformation kinetics. A description is given of the effects of certain physico-metallurgical factors on the morphology and the crystalline structure of the materials: solidification conditions and the heredity of the γ structure, cooling rate at the transformation points, and whether or not the intermediate $\gamma \rightarrow \beta$ transformation is suppressed. It is shown how a knowledge of the phase transformation processes has made it possible to define the optimum preparation conditions for these materials in the form of fuel tubes intended for the EDF reactors: casting conditions, controlled cooling treatments, weldability. The thermal stability is studied during the long duration high temperature treatments and the cycles in the two zones of the diagram $\alpha + \gamma$ and $\beta + \gamma$. The effects of the morphology (in particular the two types of α pseudo-grains observed) and of the cooling rate during the transformation point transitions are described. The mechanical properties are discussed: resistance to a tractive force, resistance to creep, resilience. These properties can also be affected by the γ structure heredity and by the cooling rate to which the alloy has been subjected. In conclusion, the reasons are discussed which led to the choice of some of these alloys for the first EDF reactors, in particular the advantages of their high creep resistance between 450 and 600°C for use in the form of tubes subjected to an external pressure. (auth)

9653 (DMS-64-25) DISLOCATION STRUCTURES IN DEFORMED AND RECOVERED TANTALUM. Technical Report No. 11. T. W. Barbee, Jr., and R. A. Huggins (Stanford Univ., Calif.). Nov. 1964. Contract Nonr-225 (34). 26p.

Dislocation structures in deformed tantalum were examined using transmission electron microscopy. It was found that the deformation structures formed in tantalum strained at temperatures between 25 and 1000°C are comparable to those found in iron on the basis of homologous deformation temperatures. Several observations pertaining to the distribution of tangles at low strains, the types of tangles formed, the mechanisms of tangle formation, and the formation of deformation cell structure from tangles are also reported. (auth)

9654 (EURAEC-1102) A STUDY ON PLASTIC FATIGUE EMBRITTLEMENT IN REACTOR VESSEL STEELS. Quarterly Report No. 2, April 1–June 30, 1964. (Belgium. Centre National de Recherches Metallurgiques, Liege). Work Performed under United States–Euratom Joint Research and Development Program. Contract 005-63-12 TEEB. 46p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Theoretical and experimental investigations of the ductility, plastic fatigue, bending, heat treatments, hardness, compression and tensile properties, and deformation of A52, ASTM A302B, Ducol-W30, and Soudotenax-56 steels are described. The development of fatigue testing machines is reported. (N.W.R.)

9655 (EURAEC-1260) GETTERING ACTION OF ZIRCONIUM INSIDE THE ELECTRON MICROSCOPE.

Gian Franco Missiroli and Tino Visani (Bologna. Università. Istituto di Fisica "A. Righi"). [1963]. Work Performed under United States—Euratom Joint Research and Development Program. 6p. (CONF-631103-1). Dep.(mn); $1.00(cy), 1(mn) OTS.

From 4th Italian Symposium on Electron Microscopy, Padua.

Transmission electron microscopic observations are presented on the dynamics of precipitation in recrystallized Zr due to its gettering action. The sequence of the growth stages as Zr is heated by the electron beam is outlined. It is concluded that the precipitation may be due to O_2 and N_2 as well as H_2. (D.L.C.)

9656 (EURAEC-1284) THE DEVELOPMENT OF A NEW METHOD TO DETERMINE THE BRITTLE-DUCTILE TRANSITION IN STEEL (IN PARTICULAR WITH RESPECT TO EMBRITTLEMENT BY IRRADIATION USING SPECIMENS OF THE ORDER OF 0.15 cm^3). Report No. M 64-1227-26150. Period Covered: November 1963—November 1964. H. C. van Elst (Netherlands. Nijverheidsorganisatie, TNO, The Hague). Dec. 21, 1964. Work Performed under United States—Euratom Joint Research and Development Program. Contract 068-61-11-RDN. 45p. Dep.(mn); $2.00(cy), 2(mn) OTS.

A stress wave attenuation test using the split Hopkinson bar is described which allows one to evaluate the energy absorption by cylindrical specimens with length of ca 6 mm and diameter of ca 6 mm at transmittance of stress waves, incident with 130 kg/mm^2 peak value and 5 μsec half time values. Such stress-time endurances have been determined to occur at the tip of a running brittle fracture in steel at the Robertson test, using high speed photographical and electronical observation methods. The energy absorption shows a sudden rise at increase of temperature, similar to the impact energy loss values at impact tests, which marks the brittle-ductile transition. The results on some reactor vessel pressure steels are compared with Charpy-V- and Robertson test results. This method will allow one to study radiation damage of steel in a more convenient way. (auth)

9657 (HW-SA-3770) HIGH-SPEED TESTING. R. G. Hoagland (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [nd]. Contract AT(45-1)-1350. 15p. (CONF-641106-2). Dep.(mn); $1.00(cy), 1(mn) OTS.

From American Society of Metals Meeting, Richland, Wash.

Problems which are encountered at testing speeds up to shock wave speeds are higher, include the controlled application of transient forces and the accurate measurement of stress and strain. A discussion is presented of several impact and high-speed nonimpact machines that were developed for treating these problems. The effect of loading rate on the fracture strength of notched A-302B steel is shown. (D.L.C.)

9658 (IS-994) THE EFFECT OF NITROGEN ON THE STRAIN AGING AND BRITTLE-DUCTILE TRANSITION OF VANADIUM. Robert W. Thompson and O. N. Carlson (Ames Lab., Ames, Iowa). Aug. 1964. Contract W-7405-eng-82. 105p. Dep.; $4.00(OTS)

The purposes of this investigation were to determine the effect of nitrogen on the strain aging and brittle-ductile transition of iodide vanadium and to determine the basic mechanisms responsible for the occurrence of these results. All of the mechanical effects generally associated with strain aging were observed. A study of the dynamic effects was characterized by the occurrence of a strain-aging peak and, from the activation energy determined from the strain rate dependence of this peak, it was concluded that the diffusion of nitrogen with the moving dislocations was responsible for this peak. From a study of the return-of-yield point after straining and aging, it was concluded that nitrogen was also responsible for the occurrence of the yield point observed in vanadium. Nitrogen does not embrittle vanadium when present in amounts below about 2000 ppm while alloys containing greater than this amount of nitrogen exhibit a brittle-ductile transition temperature which increases with increasing nitrogen content. The transition temperature for single crystals is 50 to 60°C lower than that for the corresponding polycrystalline specimen. Carbon does not promote cleavage fracture in vanadium but when present as a carbide phase suppresses the occurrence of mechanical twinning. (auth)

9659 (LA-DC-6594) DISPERSION CURVES FOR PHONONS IN DIAMOND. J. L. Warren, R. G. Wenzel, and J. L. Yarnell (Los Alamos Scientific Lab., N. Mex.). [1964]. Contract W-7405-eng-36. 15p. (CONF-804-2). Dep.(mn); $1.00(cy), 1(mn) OTS.

From Symposium on the Inelastic Scattering of Neutrons, Bombay, Dec. 1964.

A three-axis neutron diffraction spectrometer is used to measure the dispersion curves for phonons propagating in the (100) and (111) directions in diamond. The measurements verify that diamond is not homologous to Si and Ge. (T.F.H.)

9660 (ML-TDR-64-166) EFFECT OF STRESS VARIATION ON CREEP OF A SUPER ALLOY AT ELEVATED TEMPERATURES. Ryoichi Koterazawa (Minnesota. Univ., Minneapolis). Apr. 1964. Contract AF33(657)-7453. 118p. (AD-603058). $4.00(OTS)

An investigation was conducted to evaluate the effect of cyclic stress on the creep of a super alloy at elevated temperature. Special attention was given to the frequency effect, and experiments were carried out for a wide range of frequencies, from one cycle per day to 300 cycles per minute, where test data are lacking. Results of experiments showed that there is a relatively narrow transient range of frequencies where the effect of frequency is large and that this transient range shifts quite regularly with the change of stress and temperature. The strengthening of material by cyclic stress was found to be an important controlling factor of this phenomenon. However, another factor, recovery effect, was found to be more significant. Some deteriorating of the material was observed in the case where the rest period is much larger than the loading period. Also, cycle dependent fatigue damage was observed in the case of high alternating stress at high frequency. (auth)

9661 (NASA-CR-54203) DETERMINATION OF ELEVATED-TEMPERATURE FATIGUE DATA ON REFRACTORY ALLOYS IN ULTRA-HIGH VACUUM. First Quarterly Report, July 1, 1964—October 1, 1964. C. R. Honeycutt and J. C. Sawyer (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). Nov. 4, 1964. Contract NAS-3-6010. 27p. (N64-34000). $1.00 (OTS).

A preliminary design for the vacuum fatigue test chambers has been developed in cooperation with the equipment vendor. This design, which is described briefly, makes extensive use of facilities already on hand for the vacuum creep program. In addition, a bench test setup of the proposed design for the vibration loading system has been constructed and is in use to study problems of efficiency and reliability. (auth)

9662 (NASA-CR-54228) GENERATION OF LONG-TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES. Fifth Quarterly Report, June 26, 1964—September 26, 1964. J. C. Sawyer and C. H. Philleo (Thompson Ramo Wooldridge Inc. TRW Electromechanical Div., Cleveland). Nov. 9, 1964. Contract NAS 3-2545. 27p. (N65-12016). $0.50(OTS)

Twelve of the fourteen ultra high vacuum creep furnaces and the central control console are now being installed and two of these units have been placed in operation. Creep data are presented for FS-85 niobium alloy at 2000°F, 7000 psi and for tungsten—25% rhenium alloy at 3200°F, 5000 psi. Various problems affecting the 1,000 and 10,000 hour reliability of the system have been encountered. These problems and the corrective measures taken are described. (auth)

9663 (NASA-TN-D-2568) ANOMALOUS ELECTRICAL RESISTIVITY OF PALLADIUM-DEUTERIUM SYSTEM BETWEEN 4.2° AND 300°K. Robert J. Smith (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Jan. 1965. 7p. $1.00 (OTS).

The electrical-resistivity data of the palladium–deuterium (Pd-D) system with an atom ratio D/Pd of approximately 0.65 contain a peak near 40°K. This peak is similar to that obtained for the palladium–hydrogen (Pd–H) system and is accounted for by octahedral-tetrahedral transitions of some of the deuterium ions in the face-centered cubic lattice of palladium. Also, the resistivity is proportional to the temperature between 110°K and room temperature, as might be expected for palladium with a filled d-band; however, this relation is nonlinear for the Pd–H system, which indicates a broader temperature range for octahedral-tetrahedral transitions by hydrogen ions. (auth)

9664 (ORNL-3728) ROOM-TEMPERATURE MECHANICAL PROPERTIES OF EGCR-TYPE AGOT GRAPHITE. B. L. Greenstreet, J. E. Smith, F. J. Witt, G. T. Yahr, S. E. Moore, and J. G. Merkle (Oak Ridge National Lab., Tenn.). Jan. 1965. Contract W-7405-eng-26. 81p. Dep.; $3.00(OTS)

Numerous uniaxial and flexural tests were performed on EGCR-type AGOT graphite at room temperature. Moduli of elasticity, fracture stresses, fracture strains, stress-strain diagrams, ultimate strain energies, and strain ratios were obtained. The two most important conclusions reached from comparisons of the data are that (1) size effects, including volume and cross-sectional area, are small or nonexistent within the size range investigated, and (2) the behavior is the same in flexural and in uniaxial tests. The analyses provide a first step in establishing failure criteria. Significant differences exist between the tensile and compressive results; however, the material conforms fairly well to the assumption of transverse isotropy. The data distributions for the stress-strain diagrams are shown, in the main, to be normal, and analytical expressions characterizing the relationship between stress and strain are presented. The fracture stresses were examined according to Weibull's statistical theory of failure, and it was shown that the more important implications of the theory are not supported by the data. (auth)

9665 (UCRL-11067) MODERN METALLOGRAPHIC TECHNIQUES. G. Thomas (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). Nov. 8, 1963. Contract W-7405-eng-48. 71p. (CONF-631102-1). Dep.(mn); $3.00(cy), 2(mn) OTS.

From Aerospace Materials Conference, Los Angeles.

A general survey is presented of new metallographic techniques for direct structural observations. Etch pit techniques, electron and x-ray microscopy, thermionic emission and field ion microscopy, and probe microanalysis are discussed. (D.L.C.)

9666 (UCRL-11687) THEORY AND BACKGROUND OF FRACTURE MECHANICS. Earl R. Parker (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1964. Contract W-7405-eng-48. 52p. (CONF-778-4). Dep.(mn); $3.00(cy), 1(mn) OTS.

From Metals/Materials Congress, Philadelphia, Oct. 1964.

Ductile materials can exhibit several modes of transcrystalline fracture, even under uniaxial tensile loading. Although there are only two basic kinds of separation processes, shear and cleavage, the presence of notches can modify either mode so that the energy absorbed (i.e., notch toughness) prior to fracture is markedly altered. Notch toughness, as measured by G_c or K_c, depends upon the volume of material that has been plastically deformed prior to fracture. The specimen geometry, the temperature of testing, and the strain rate all affect the energy absorption. Thicker plates, sharper notches, lower temperatures, and higher loading rates all tend to decrease the volume of plastically strained material and thus lower notch toughness. Fractures in plates are often of mixed types, with the amount of each varying as the crack grows. This fact, as well as others, makes it impossible to establish a unique value of G_c for a given material. Quantitative mathematical approaches to this problem have been attempted, but they have met with limited success. However, the problems, while complex, should be soluble. Quantitative analyses should eventually be developed which would permit the prediction of notch toughness from fundamental considerations such as tensile data, specimen geometry, temperature, and strain rate. (auth)

9667 (USBM-RC-1119) COEFFICIENTS OF THERMAL LINEAR EXPANSION OF FUSED HAFNIUM CARBIDE–CARBON ALLOYS. (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Oct. 1964. Contract AT(11-1)-599. 22p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A study was conducted to determine the thermal linear expansion coefficients of ingots of arc-melted and cast hafnium carbide and also of ingots of hafnium carbide containing free graphite, and to compare the value with those given in the literature for the powder metallurgy product of hafnium carbides. The average coefficients were determined for various temperature ranges from 100 to 200°C, 100 to 300°C, etc. up to 100 to 900°C for hafnium carbide with 5.1 weight percent total carbon and for hafnium carbide–carbon alloys with 7.7, 10.4, and 12.3 weight percent total carbon. The single-phase region of hafnium carbide, 4.0 to 5.8 weight percent carbon, included the 5.1 weight percent carbon composition of 6.3 weight percent. The coefficient of linear expansion increased with increasing temperature up to 900°C and increased with decreasing carbon content with the exception that the lowest coefficient was for the single-phase hafnium carbide (5.1 weight percent carbon). The coefficient for fused hafnium carbide was very nearly the same as the maximum reported within a corresponding temperature range for the powder metallurgy product. (auth)

9668 (WERL-8844-2) DETERMINATION OF ENERGY RELEASE RATE FOR BIAXIAL BRITTLE FRACTURE SPECIMEN. A. J. Bush and W. K. Wilson (Westinghouse Electric Corp. Research Labs., Pittsburgh). Aug. 1964. Contract NObs 78844. 28p. Dep.(mn); $2.00 (cy), 1(mn) OTS.

A compliance study was made on a 4X biaxial specimen to determine the numerical factor, C_1, in the expression used for the energy release rate, G, for the biaxial brittle fracture specimen developed by M. J. Manjoine. The variation of C_1 with crack length or notch depth was also determined. For the standard geometry specimen, the factor, C_1, was found to be 0.722. This value is approximately the same as that determined in another recent study at the Research Laboratories by A. M. Wahl, M. M. Leven, and W. K. Wilson. (auth)

9669 (WERL-8844-3) PLANE STRAIN FRACTURE TOUGHNESS MEASUREMENTS OF THREE A302B MATERIALS BY MEANS OF SPIN TEST. G. O. Sankey and J. H. Bitzer (Westinghouse Electric Corp. Research Labs., Pittsburgh). Dec. 1964. Contract NObs-78844. 13p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The plane strain fracture toughness of three A302B materials was determined by spin test. It was found that fracture strength varies linearly with test temperature. Fracture toughness values are given for the completely plane strain case and for notch apex acuity of crack proportions. (auth)

9670 (AI-Trans-69) MEDIUM TEMPERATURE REACTION BETWEEN LANTHANIDE AND ACTINIDE CARBIDES AND HYDROGEN. Guy Dean, Robert Lorenzelli, and Roger Pascard (France. Commissariat à l'Energie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Translated by Anthony Cornell (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.), from report CEA-R-2602. [1964]. 39p. Dep.(mn); $3.60(fs), $1.37(mf) JCL.

A laboratory investigation was made on the adsorption of hydrogen by UC, PuC, ThC, YC, HoC, ErC, and TiC at temperatures up to 700°C. The crystal structure parameter was also measured as a function of hydrogenation. The results show that one hydrogen molecule is adsorbed for every carbon vacancy in the lattice. The fcc structure of the actinide carbides remains unchanged with a lattice expansion; however, at 400°C, further hydrogen adsorption in PuC leads to a PuH_2-type structure with carbon atoms in octahedral sites. For the lanthanide carbides, the structure of the carbohydrides is hcp like that of the metal. (D.L.C.)

9671 (JPRS-27593) CONSTRUCTION MATERIALS FOR THE ACTIVE ZONE OF NUCLEAR REACTORS. A. S. Zaymovskii, V. V. Kalashnikov, and I. S. Golovnin. Translation of p.71-159 from "Teplovydelyayushchie Elementy Atomnykh Reaktorov," Moscow, 1962. 97p. (TT-64-51821) $3.00(OTS).

A review is presented of: requirements for reactor construction materials; selection of materials for fuel cladding and canning; general, mechanical, and physical properties of construction materials; compatibility of materials with fuel coolants; thermal fatigue; and effects of neutron irradiation on construction materials. 107 references. (T.F.H.)

9672 (ORNL-tr-385) THEORY OF THE FORMATION OF S-SHAPED KINK BANDS IN PLASTICALLY DEFORMED METAL CRYSTALS. II. DISLOCATION ARRANGEMENT, STABILITY AND COURSE OF DEVELOPMENT OF THE KINK BAND. Hartwig Mueller. Translated for Oak Ridge National Lab., Tenn., from Z. Metallk., 50: 351-6(1959). 18p. Dep.(mn); $1.60(fs), $0.80(mf) JCL.

The development of kink bands from dislocation walls is discussed. A wall model of the kink band is used to determine the equilibrium distances of the arranged dislocations. The deviations from the model are considered. The stresses that can be withstood by the defects are determined and compared with the wall model. It is concluded that the anchoring is sufficient to stabilize the dislocation wall. (D.L.C.)

9673 (SC-T-64-2011) THE EFFECT OF EXTREMELY HIGH COOLING RATE ON THE SOLIDIFICATION AND STRUCTURE OF BINARY ALLOYS. G. Falkenhagen and Wilhelm Hofman. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Z. Metallk., 43: 69-81(1952). 41p. Dep.(mn); $4.60(fs), $1.43(mf) JCL.

Quenching tests were conducted on the following alloys: Al−Ti, Al−V, Al−Cr, Al−Mn, Al−Fe, Pb−Na, Pb−Te, Pb−Ca, and Cu−Cr. The oversaturation of the mixed crystals which were formed was measured. The temperature course during solidification was also measured for some of the alloys as well as for pure Al, Cu, and Pb. The dissociation of mixed crystals solidified in oversaturation was studied for Al alloys and Pb−Na alloy. The calculation of the propagation velocity of the solidification front is considered. (D.L.C.)

9674 ON THE STRUCTURAL RELATION BETWEEN NIOBIUM− AND TANTALUM−WOLFRAM OXIDES AND THE TETRAGONAL POTASSIUM WOLFRAM BRONZE. Arthur Sleight and Arne Magneli (Univ. of Stockholm). Acta Chem. Scand., 18: 2007-8(1964).

Tungsten, niobium, and tantalum powders were mixed and oxidized in air at 500°C. The resulting mixture of oxides was then sealed in a platinum tube and heated at temperatures from 1200 to 1400°C for 1 to 3 days. In both of the ternary systems, phases bearing structural resemblance to tetragonal K_xWO_3 were observed. The high density of the compounds indicated that the stoichiometric deviation of the phase from the metal to oxygen ratio 1 : 3 is due not to the presence of oxygen vacancies but to atoms occupying interstitial positions in the WO_3 framework of the K_xWO_3 structure. (M.C.G.)

9675 LAYER STRUCTURE POLYTYPISM AMONG NIOBIUM AND TANTALUM SELENIDES. Bruce E. Brown and Donald J. Beerntsen (Allis-Chalmers Mfg. Co., Milwaukee). Acta Cryst., 18: 31-6(Jan. 10, 1965).

Single crystals of several varieties of tantalum and niobium selenide layer structures were grown by vapor transport methods. Two two-layer forms had the NbS_2 structure, a three-layer form was like rhombohedral MoS_2, and two four-layer forms were structures with a selenium stacking sequence of AABBAACC ..., and AABABBAB ..., respectively. These were refined by least-squares methods. Refinement adjusted the c coordinates of the selenium atoms 0.1 Å away from positions in which each atom sheet is spaced at equal intervals along z. This adjustment moved the selenium atoms away from the interleaving metal atoms. The trigonal prism coordination units in the niobium and tantalum compounds tended to be slightly shorter in the z direction and longer in the x direction than similar molybdenum coordination units. (auth)

9676 NEUTRON DIFFRACTION STUDIES OF THE ORDER OF THE ATOMS IN THE P PHASE AND THE R PHASE. Clara B. Shoemaker, David P. Shoemaker, and John Mellor (Massachusetts Inst. of Tech., Cambridge). Acta Cryst., 18: 37-44(Jan. 10, 1965).

Ordering of the atoms in two ternary alloys, P phase (Mo−Ni−Cr) and R phase (Mo−Fe−Mn), both structurally related to the σ phase, was studied by powder neutron diffraction. The at. % Mo on each site was taken to be approximately that determined in previous x-ray single-crystal studies, which showed that Mo preferentially occupies CN16 and CN15 sites. From the best fit between observed and calculated neutron diffraction diagrams it was apparent that, in the P phase, Ni preferentially occupies CN12 positions. In the R phase, Mn showed only a slight preference for CN14 and CN15 positions over CN12 positions when competing with Fe. The results were consistent with those of ordering studies of related transition element intermetallic compounds. (auth)

9677 THE STRUCTURE OF YNi. J. F. Smith and D. A. Hansen (Ames Lab., Ames, Iowa). Acta Cryst., 18: 60-2(Jan. 10, 1965). (IS-824)

The structure of the intermediate phase YNi was determined by x-ray diffraction with single-crystal techniques. YNi crystallized with monoclinic symmetry in space group $P2_1/b$ (C^5_{2h}). The lattice parameters are $a = 4.114$, $b = 7.14$, and $c = 5.501$ Å with $\gamma = 90.0 \pm 0.5°$. The atomic arrangement is pseudo-orthorhombic and differs from the B27 type structure only in a displacement of atomic coordinates along the short crystallographic axis. (auth)

9678 THE CRYSTAL STRUCTURE OF $Li_{15}Ge_4$. Q. Johnson, Gordon S. Smith, and D. Wood (Univ. of California, Livermore). Acta Cryst., 18: 131-2(Jan. 10, 1965). (UCRL-7936)

An investigation was made of the Li-Ge system to determine whether a compound isomorphous with $Li_{22}Pb_5$ exists. X-ray powder diffraction studies indicated the presence of two phases. Not only the sought for face-centered phase isomorphous with $Li_{22}Pb_5$, but a body-centered phase with $a = 10.72 \pm 0.05$ Å was observed. Studies were undertaken to determine the composition and structure of this phase. It was concluded that it is the intermetallic compound $Li_{15}Ge_4$. (M.C.G.)

9679 ELECTRICAL RESISTIVITY CHANGE IN COLD-WORKED TUNGSTEN WIRES DURING RECOVERY AND RECRYSTALLIZATION. Elisabeth Kovács-Csetényi (Research Inst. for Technical Physics, Budapest). Acta Phys. Acad. Sci. Hung., 18: 11-18(1964).

The isochronal annealing of cold-worked tungsten, with K, Si, and Al impurity contents, showed that the electric resistivity measured in liquid air decreases in stages with increasing temperature. From simultaneous microscopical and isothermal annealing investigations it was found that the first stage, which was observed above 900°K, is due to the rearrangement of the dislocations, while the second and the third stage arise from primary and secondary recrystallization. The resistivity of the samples, which contained K, Si impurities, decreased continuously, because in this case the secondary recrystallization took place quickly after the primary recrystallization. The resistivity change in the first stage showed logarithmic kinetics. The activation energy was 110 ± 10 kcal/mole for both samples, which is an estimate for the activation energy of self-diffusion in tungsten. (auth)

9680 EXTRUSION STRENGTHENING BY MANGANESE IN MAGNESIUM−THORIUM ALLOYS. Kan Wang, Su-fe Hu, and Chao-yung Chen. Chin Shu Hsueh Pao, 6: 65-73(1963).

It is shown that when manganese is added to binary magnesium–thorium alloys the recrystallization temperature and the stress rupture strength of the alloys both increase after extrusion. The reason for the increase in the recrystallization temperature is possibly due to the enrichment of manganese in subgrain boundaries of the alloys in the cast condition. These substructures being absent in binary magnesium–thorium alloys, recrystallization of these alloys occurs easily. If the heterogeneity of the alloying elements in the subgrain boundaries in ternary alloys were destroyed by homogeneous treatment, recrystallization would also take place easily. The cause of the substructure formation is very possibly due to the fact that the distribution coefficient of manganese in the ternary phase diagram is very small. As regards the increase in strength, it is mainly due to the anisotropy of mechanical properties of the alloys caused by the retained extrusion texture as a result of the increase in the recrystallization temperature. (Sci. Abstr. China, Tech. Sci., No. 6, 1963)

9681 STRUCTURE AND PROPERTIES OF THE VANADIUM-RICH CORNER OF VANADIUM–NIOBIUM–TUNGSTEN TERNARY ALLOY SYSTEM. Nai-lih Wang, V. V. Baron, and E. M. Savitsky. Chin Shu Hsueh Pao, 6: 155-62(1963).

The phase equilibrium diagram of the vanadium-rich corner of the vanadium–niobium–tungsten ternary alloy system (up to 25% Nb, 16.6% W) was established by means of metallographic study, thermal analysis, and testing of mechanical properties. An investigation of the vertical sections with a ratio of (Nb/W) = 2 as well as (Nb/W) = $\frac{1}{2}$ was also made. It is shown that within the range of the alloy compositions under investigation there exists a series of continuous solid solutions. The identical crystal lattice, close atomic radii, and similar electron structures of these three metals are considered as the possible explanation for such complete miscibilities. The variation in property of the alloys in this system is in accordance with the characteristics of an alloy system having unlimited solid solubility in solid state. By adding niobium and tungsten to the carbon-thermal vanadium of a certain purity, its hardness is raised appreciably at both room and high temperatures. At the same time, its plasticity and ultimate strength during compression test are lowered, i.e., the alloys are made to be harder and more brittle. It is believed that these ternary alloys would have good mechanical properties at high temperatures, should purer vanadium be used as solvent. It was also found that niobium improves slightly the oxidation resistance of vanadium at 1,000 and 1,200°C, while tungsten makes it deteriorate when above 1,000°C. At both temperatures vanadium and its alloys are seriously oxidized. (Sci. Abstr. China, Tech. Sci., 2: No. 1, 1964)

9682 ACTIVATION ENERGIES FOR DIFFUSION AND DIFFUSION COEFFICIENTS OF OXYGEN AND NITROGEN IN MOLYBDENUM. Ying-liang Ma and Jue-yih Sung. Chin Shu Hsueh Pao, 7: 68-76(1964).

Additional evidence is presented to prove that the two internal friction peaks associated with the presence of either oxygen or nitrogen in molybdenum previously observed by internal friction measurements with a torsion pendulum (two internal friction peaks of oxygen occurred at temperatures around 115 and 200°C, whereas two of nitrogen were observed at 160 and 300°C, respectively) are associated with the stress-induced micro-diffusion of oxygen and nitrogen in molybdenum. Systematic investigations were carried out to study the nature of the internal friction peaks of oxygen. The results showed that the height of the internal friction peak at 115°C was proportional to the oxygen content in solid solution, while the height of the other internal friction peak at 200°C was a quadratic function of the oxygen content in solid solution. The activation energies for diffusion were found to be 25.2 and 30 kcal/mole for the two oxygen peaks; for the nitrogen peak at 160°C the corresponding activation energy was found to be 28.5 kcal/mole. From the above results, it is believed that the 115°C peak may arise from the diffusion of free non-interacting interstitial oxygen, whereas the 200°C peak may be correlated with the diffusion of oxygen atoms each of which interacts with another oxygen atom in its neighborhood. Theoretical diffusion coefficient curves for these systems were also obtained from the relationship between activation energies and the calculated diffusion coefficient constant. (Sci. Abstr. China, Tech. Sci., 2: No. 4, 1964)

9683 ANOMALIES OF POLYMORPHISM OF POWDERED URANIUM DISPERSED IN AN INERT MEDIUM. Jean Besson, Pierre L. Blum, Phillippe Guinet, and Jean Laugier (Centre d'Etudes Nuclear, Grenoble, France). Compt. Rend., 259: 3012-15(Nov. 2, 1964). (In French)

Studies of dispersions of powdered uranium in an inert medium such as uranium dioxide or beryllium oxide revealed the existence of a reversible transformation corresponding to a direct changing of phase $\alpha \gtreqless \gamma$. The usual points of transformation, when they appeared, had alterations more or less complete on heating or cooling. The importance of these anomalies depended essentially on the homogeneity of the dispersion and of the shape of the metallic particles, whose surface energy appeared to be the origin of the phenomena observed. (tr-auth)

9684 THERMOELECTROMOTIVE FORCES AND THE ELECTRICAL CONDUCTIVITY OF VANADIUM AND NIOBIUM PENTOXIDES. A. I. Manakov, O. A. Esin, and B. M. Lepinskikh. Fiz.-Khim. Osnovy Proizv. Stali, Akad. Nauk SSSR, Inst. Met., Tr. 6-oi Konf., Moscow, 1961, 148-53 (1964).

To confirm the occurrence of conductive electrons in many solid and molten oxides, the electric conductivity and thermoelectromotive forces of solid and molten V_2O_5 and Nb_2O_5 were measured. The nature of the conductivity was identified by calculating the energy of activation and evaluated the number and mobility of current carriers. The thermoelectromotive force (temf) of V_2O_5 was measured in a 15 mm diameter quartz U-tube, placed in a crucible furnace with a thermostat. From both tube ends, Pt-Pt-Rh thermocouples were immersed into the molten V_2O_5 and the cold thermocouple junctions were connected to a pontentiometer which measured the t° and temf in both parts of the melt. The temf in Nb_2O_5 was measured in a ZrO_2 cylindrical crucible (d = 25 mm, h = 100 mm) placed in a carbon-resistance quartz-lined oven. The lower crucible section was thermoinsulated which produced a thermal gradient over the crucible height, thus permitting the determination of temf with the use of thermocouples. The results indicate that the oxides are electron semiconductors with intrinsic conductivity in the liquid state and admixture-induced conductivity in the solid state. (auth)

9685 ON THE SINTERING PROCESS OF TiC–Ni–Mo COMPACTS. Tamotsu Fukatsu and Susumu Yamaya (Toshiba Tungaloy Co. Ltd., Kawasaki, Japan). Funtai Oyobi Funmatsuyakin, 10: 167-71(1963). (In Japanese)

To study the effects of Mo-addition on the structures and properties of TiC-base cermets for cutting tool, sintering of TiC-10% Ni-10% Mo compacts was investigated. During solid state sintering, Mo converts into Mo_2C at 800 to 1000°C. The Mo_2C diffuses in TiC and a new phase is formed on surroundings of TiC particles. The new phase is intermediate in hardness of TiC and Ni phase, but it has the same crystal structure as TiC. This phase is, therefore, regarded as a solid solution of TiC and Mo_2C. Development of this phase depends upon sintering condition, especially upon temperature and is remarkable for sintering above 1400°C. Sintered compact with such solid solution phase, however, is not desirable for cutting tool materials, because it is poor in wear- and chipping-resistance. (auth)

9686 CALCULATED HIGH-TEMPERATURE ELASTIC CONSTANTS FOR ZERO POROSITY MONOCLINIC ZIRCONIA. C. F. Smith and W. B. Crandall (Pflauder Permutit, Inc., Rochester, N. Y.). J. Am. Ceram. Soc., 47: 624-7(Dec. 21, 1964).

A method was developed for hot-pressing 80 to 95% dense, polycrystalline specimens of commercially available, unstabilized, monoclinic zirconia. The elastic moduli of these specimens were measured by a sonic method in the range from 25 to 1000°C. Application of mathematical expressions developed for the porosity dependence of elastic moduli of refractory oxides led to the calculation of Young's and shear moduli of this material at zero porosity in this temperature range. (auth)

9687 LATTICE DEFECTS IN TETRAGONAL ZrO_2. Michael Hoch (Univ. of Cincinnati). J. Am. Ceram. Soc., 47: 630-2(Dec. 21, 1964).

The activity of zirconium in the tetragonal ZrO_2 phase was measured at 2200 to 2300°K as a function of composition by studying the reaction $yZrO_{2-x} + ZrN \rightarrow (y + 1)ZrO_{(2-x)y/y+1} + \frac{1}{2}N_2$ (g). From the variation of the zirconium activity with composition, the pair interaction energy E_{11} between vacancies in the oxygen lattice was evaluated at -4.6 ± 1.0 kcal per mole. (auth)

9688 EFFECT OF METAL ADDITIONS ON THE MICROSTRUCTURE OF ZIRCONIA. Robert Ruh, Norman M. Tallan, and Harry A. Lipsitt (Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Am. Ceram. Soc., 47: 632-5(Dec. 21, 1964).

The diffusion of titanium into zirconia was studied to determine the mechanism by which increased sintering occurred in the metal-modified zirconias. Results revealed that the increased sintering occurred only when compositions above the solubility limit were fired considerably above the melting point of the titanium. Examination of the system Ti–Zr–O revealed that considerable liquid was present at these firing temperatures. This liquid phase promoted the sintering of the zirconia. The increased sintering did not occur for compositions above the solubility limit fired below the temperature of liquid phase formation, or for compositions below the solubility limit fired considerably above or below the melting point of titanium. (auth)

9689 ELECTRICAL PROPERTIES AND DEFECT STRUCTURE OF ZIRCONIA: I. MONOCLINIC PHASE. R. W. Vest, N. M. Tallan, and W. C. Tripp (Systems Research Labs., Dayton, Ohio and Aerospace Research Labs., Wright-Patterson AFB, Ohio). J. Am. Ceram. Soc., 47: 635-40(Dec. 21, 1964).

The defect structure of monoclinic zirconia was investigated by measuring the oxygen partial pressure dependence of the electric conductivity and sample weight. Techniques were developed to calculate the degree of nonstoichiometry and the mobility of the charge carriers from electrical and weight change data. ZrO_2 was found to be an amphoteric semiconductor at 1000°C with the transition from n-type to p-type conductivity occurring at 10^{-16} atm. The predominant defect in the oxygen excess region was shown to be completely ionized zirconium vacancies. The positive holes arising from the zirconium vacancies were found to have an extremely small mobility. (auth)

9690 COMPRESSIVE PROPERTIES OF TITANIUM-MODIFIED ZIRCONIA AT ELEVATED TEMPERATURES. Harry A. Lipsitt and Robert Ruh (Aerospace Research Labs., Wright-Patterson, AFB, Ohio). J. Am. Ceram. Soc., 47: 645-6(Dec. 21, 1964).

Two titanium-modified zirconias, with 1.7 and 5.6 at.% titanium on a ternary composition basis, were studied. Specimens were fired to 2000°C for 2 hr, cooled at the rate of 50°C per min, and machined into cylinders. Aging treatments at 10^{-8} and 2×10^{-5} torr were performed with the specimen in place in the testing fixture. The ultimate compressive strengths were essentially independent of composition over the entire temperature range so a single curve is shown for both compositions. There was a strength increase due to aging, which was dependent on time, temperature, and oxygen pressure. It was also found that the aging effect is a surface phenomenon, which occurs to a depth of approximately 0.016 in. in 20 hr at 600°C. The effect was not transient but was retained on cooling to room temperature. (M.C.G.)

9691 THE SYSTEM PuO_2–MgO. D. F. Carroll (General Electric Co., Richland, Wash.). J. Am. Ceram. Soc., 47: 650(Dec. 21, 1964). (HW-SA-3552)

Phase studies were made of PuO_2–MgO systems and a proposed diagram is presented. (M.C.G.)

9692 ELASTIC CONSTANTS OF SINGLE CRYSTAL ThO_2 AT 25°C. P. M. Macedo, W. Capps, and J. B. Wachtman, Jr. (National Bureau of Standards, Washington, D. C.). J. Am. Ceram. Soc., 47: 651(Dec. 21, 1964).

Single crystals of ThO_2 were studied to determine elastic constants. The velocity of 45 MH sound waves was measured using a pulse echo technique with the ThO_2 specimen mounted on the end of a vitreous silica buffer rod with stopcock grease bonds for longitudinal waves and epoxy resin bonds for transverse waves. The three elastic constants were computed from the velocity of longitudinal waves, of transverse waves polarized along the [001] direction, and of transverse waves polarized along the $[1\bar{1}0]$ directions. The resulting elastic constants in units of 10^{11} N/m^2 (10^{12} dyne/cm^2) are $C_{11} = 3.67 \pm 0.04$, $C_{12} = 1.06 \pm 0.02$, and $C_{44} = 0.797 \pm 0.008$. The elastic anisotropy factor has a value of 0.61. (M.C.G.)

9693 AN X-RAY LINE BROADENING STUDY OF THE INTRODUCTION AND REMOVAL OF STRAIN IN SOME REFRACTORY OXIDES. D. Lewis and M. W. Lindley (Battersea Coll. of Tech., London). J. Am. Ceram. Soc., 47: 652-3(Dec. 21, 1964).

Deformation studies were made on oxides of Mg, Ca, Th, and Al. Before deformation each oxide was annealed at 1350°C for 2 hr. This produced well-resolved Bragg reflections. The oxides were then cold worked by milling in an agate ball mill for 2 hr. They were then reannealed at 1350°C for 2 hr and studied with x rays. Shap Bragg reflections, similar to those obtained from the original annealings, were obtained. The α_1 and α_2 doublet components of the filtered Cu Kα radiation were separated by Rachinger's method, and the integral breadth, β, for each diffraction profile was then obtained. The excess broadening of the worked specimens was calculated from these two distributions. It was found that strain can be introduced and removed in refractory oxides by ball-milling and annealing. (M.C.G.)

9694 PHASE EQUILIBRIUM IN THE SYSTEM Nd_2O_3–SiO_2. R. O. Miller and D. E. Rase (Alfred Univ., N. Y.). J. Am. Ceram. Soc., 47: 653-4(Dec. 21, 1964).

Mixtures were prepared from Nd_2O_3 and/or $Nd(NO_3)_3 \cdot 6H_2O$ and SiO_2. They were pelletized and reacted at elevated temperatures. Phases were identified and characterized by x-ray and petrographic techniques. The data and results are summarized in a phase diagram presented. Evidence of a stability minimum for $Nd_2Si_2O_7$ phase was obtained. (M.C.G.)

9695 MAGNETIC AND STRUCTURAL CHARACTERISTICS OF LANTHANIDE–COPPER COMPOUNDS. R. E. Walline and W. E. Wallace (Univ. of Pittsburgh). J. Chem. Phys., 42: 604-7(Jan. 15, 1965).

Magnetic characteristics and structures of 11 intermetallic compounds represented by the formula LnCu are reported. The compounds with Ln = Ce, Pr, Nd, and Sm occurred in the FeB structure; those with Ln = Y, Gd, Tb, Dy, Ho, Er, and Tm had the CsCl structure. YCu was a Pauli paramagnet. The magnetic characteristics of PrCu and NdCu were anomalous and attempts to deduce the nature of the cooperative magnetic phases in these materials, if any, at low temperatures were unsuccessful. Results for the other compounds suggested that they are antiferromagnetic at low temperatures. TbCu and HoCu exhibited two magnetic transitions; the high-temperature transition was interpreted as the Nèel point and the one at the lower temperature as an order-order transition in the antiferromagnetic state. In the paramagnetic region effective moments in good agreement with the free tripositive ion values were observed in all cases except for GdCu and ErCu. A variable moment was observed for ErCu whereas for GdCu a moment of 8.46 μ_B was obtained. (auth)

9696 ELECTRICAL RESISTIVITY AND DIFFUSIONLESS PHASE TRANSFORMATIONS OF ZIRCONIA AT HIGH TEMPERATURES AND ULTRAHIGH PRESSURES. E. Dow Whitney (Carborundum Co., Niagara Falls, N. Y.). J. Electrochem. Soc., 112: 91-4(Jan. 1965).

The resistivity of chemically pure monoclinic zirconia was investigated at pressures to 45,000 bars and temperatures to 1200°C. Measurements were made on thin, prepressed wafers of ZrO_2 situated between the opposed, cemented carbide Bridgman anvils of a uniaxial Griggs and Kennedy simple squeezer. Observation of discontinuous changes in electrical resistance at various temperatures under isobaric conditions were used to define the phase diagram. The pressure dependence of the temperature of the reversible monoclinic ⇌ tetragonal phase transition in ZrO_2 agreed with the slope of the P-T equilibrium curve up to 15 kilobars as calculated from thermodynamics, i.e., $dT/dP = -3.02 \times 10^{-2}$ degrees bar^{-1} (1). Activation energy for electrical conduction followed the Arrhenius equation and was found to be pressure dependent, decreasing from 3.56 ev at atmospheric pressure to an apparently constant value of 0.86 ev from 30 to 45 kilobars. (auth)

9697 DEFORMATION OF TUNGSTEN SINGLE CRYSTALS FROM −77°C TO 800°C. R. H. Schnitzel (Westinghouse Lamp Div., Bloomfield, N. J.). J. Less-Common Metals, 8: 81-9(Feb. 1965).

Single crystals of tungsten prepared by electron beam melting were tested in tension over a temperature range from −77 to +800°C. The temperature dependence of the yield stress was found to be similar to that of polycrystalline tungsten. At temperatures below 300°C, the temperature dependence of the yield stress of both materials was about the same. In an intermediate temperature region from 300 to 800°C, yield stress anomalies (peaks and valleys) were found for both the single crystal and the polycrystalline tungsten. These yield stress effects are attributed to the precipitation of interstitials. (auth)

9698 OBSERVATIONS ON MICROSTRUCTURE AND SUPERCONDUCTIVITY IN THE Nb−H SYSTEM. G. C. Rauch, R. M. Rose, and J. Wulff (Massachusetts Inst. of Tech., Cambridge). J. Less-Common Metals, 8: 99-113 (Feb. 1965).

The microstructure and magnetization of 4.2°K of hydrided niobium specimens in the two-phase and single-phase regions were investigated. The habit plane and crystallographic nature of the transformation for the hydrided phase were consistent with previous findings. The hydride phase was found to be non-superconducting at temperatures above 1.8°K. Evidence of coherency strains was present. Evidence for the connectivity and distribution of the two phases was found in the magnetization data. A high degree of irreversibility and trapped flux indicated continuity of the superconducting niobium-rich phase, which was checked by metallographic observation. Only the bulk properties of the phase were observed when the superconducting phase was not continuous. For very fine distributions of the hydride, extensive fluxoid pinning effects were noticed. These may be attributed to a decoration of the substructure of the starting material by the hydride. (auth)

9699 THE CRYSTAL STRUCTURES OF VNi_2, VPd_2, VPt_2, AND RELATED AB_2 PHASES. B. C. Giessen and N. J. Grant (Massachusetts Inst. of Tech., Cambridge). J. Less-Common Metals, 8: 114-19(Feb. 1965).

Isomorphous AB_2 phases of the $MoPt_2$-type were found in six of the nine AB_2 combinations with A = V, Nb, Ta; and B = Ni, Pd, Pt. Their structures were completely determined and compared with other known AB_2 phases; interatomic distances are presented; and previous literature data were reviewed and corrected. (auth)

9700 GRAPHITE PORE STRUCTURE EVALUATION BY SERIAL SECTION KINEMATOGRAPHY. J. W. Stammers (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Phot. Sci., 11: 351-4(1963).

The method and techniques employed in the investigation of the pore structure of graphites by serial sectioning combined with kinemicrography are discussed. Some of the simpler problems associated with the working of graphite samples to a good finish and yet with reasonable speed are also reviewed. (auth)

9701 MAGNETIC BREAKDOWN IN METALS. John R. Reitz (Case Inst. of Tech., Cleveland). J. Phys. Chem. Solids, 25: 53-8(1964).

The condition for magnetic breakdown (i.e., the breakdown of semiclassical orbits determined by the band structure of the metal) is obtained quantum mechanically from a calculation of the transition rate between different magnetic levels, the periodic potential acting as the perturbation. It is found that the transition probability has an oscillatory component (oscillatory in the magnetic field). In averaging over the different orbits on the Fermi surface which contribute in a particular experiment, it is found that the oscillatory behavior tends to wash out; in the semiclassical limit the criterion for breakdown is of the form derived by Blount using a different argument. The effect of geometry on magnetic breakdown and the possibility of observing oscillatory magnetic breakdown is discussed. (auth)

9702 PLASMA OSCILLATION OF ELECTRONS IN ALLOY. I. Ag−Al ALLOY. Fuminori Funimoto and Osamu Sueoka (Tokyo Univ.). J. Phys. Soc. Japan, 19: 2069-77(Nov. 1964).

The characteristic electron energy loss spectra of Ag-Al alloy are studied at various compositions using the Möllenstedt-type analyzer with the primary electron energy of 30 kev. The energy loss due to the plasma oscillation decreases continuously from 3.5 to 3.3 ev with increase of concentration of Al and varies to 14.8 ev at 70 atomic per cent Al discontinuously. The intermediate energy value of plasma excitation between 3.5 and 14.8 ev is not observed. The 14.8 ev energy loss shows always a clear dispersion, i.e., the change in energy value with scattering angle, as is the case for pure Al. The other energy loss values vary discontinuously at 20 and 70 atomic per cent of Al. The discontinuous change of plasma energy can be explained by taking account of the interaction between the plasma oscillation and the inter-band transition. The energy spectra of ζ-phase (h-c-p type) and μ-phase (β-Mn type) alloys are also observed. These spectra are quite different from the above spectra, and the plasma energies of ζ-phase and μ-phase are considered to be 5.2 and 4.5 ev, respectively. (auth)

9703 MAGNETIC STRUCTURE OF THE INTERMETALLIC COMPOUND MnHg. Yasuaki Nakagawa (Atomic Energy of Canada Ltd., Chalk River, Ont.), Hiroshi Watanabe, and Tomiei Hori. J. Phys. Soc. Japan, 19: 2078-82 (Nov. 1964).

The antiferromagnetic structure of MnHg was investigated by neutron diffraction measurements on the powder sample. The Mn atoms are arranged on a simple cubic lattice, which splits into two face centered cubic sublattices so that the magnetic moments on one sublattice are antiparallel to those on the other. The magnetic moment of a Mn atom is close to 4 Bohr magnetons. The angles between the magnetic moments and the crystallographic axes remain undetermined. The Néel point is evidently higher than 300°K, and there is no remarkable change in the neutron diffraction pattern at 198°K, where the magnetic susceptibility exhibits a distinctive anomaly and the crystal lattice undergoes a slight distortion from cubic to tetragonal symmetry. (auth)

9704 NEUTRON DIFFRACTION STUDIES OF Mn−Zn ALLOYS. Yasuaki Nakagawa (Atomic Energy of Canada Ltd., Chalk River, Ont.) and Tomiei Hori. J. Phys. Soc. Japan, 19: 2082-7(Nov. 1964).

Neutron diffraction measurements were made on Mn-Zn alloys in order to investigate the magnetic structures and the atomic superlattice structures. The following superlattices were confirmed: α'-$MnZn_3$ is of the Cu_3Au type, ϵ'-$MnZn_3$ of the Ni_3Sn type, and β_1-MnZn of the CsCl type. Crystallographic and magnetic structures of β-Mn_3Zn_2 are similar to those of β_1-MnZn. Both ϵ'-$MnZn_3$ and β_1-MnZn exhibit a spontaneous magnetization at room temperature. It seems that the former is simply ferromagnetic while the latter has an angular arrangement of the magnetic moments. An antiferromagnetic structure of α'-$MnZn_3$ at low temperatures is associated with a tetragonal distortion of the lattice, in which the magnetic moments in a c-plane are parallel to each other and antiparallel to those in adjacent c-planes. (auth)

9705 THERMOELECTRIC POWER OF DILUTE ALKALI METAL ALLOYS AT LOW TEMPERATURES.

K. Fischer (Kernforschungsanlage, Julich, Ger.). Phys. Letters, 13: 18-19(Nov. 1, 1964).

It was previously found that the thermoelectric power of alkali metals which contain atoms of other alkali metals in solid solution has a positive sign at very low temperatures whereas the simple theory using free electrons scattered by a screened Coulomb potential or a square potential yields a negative sign. A model is presented which yields the correct sign for the thermopower. (C.E.S.)

9706 MAGNETOACOUSTIC EFFECT IN RHENIUM AT 390 Mc/s. C. K. Jones (Westinghouse Electric Corp., Pittsburgh) and J. A. Rayne. Phys. Letters, 14: 13-14 (Jan. 1, 1965).

The observation of magnetoacoustic oscillations in rhenium is reported. Measurements were made at 390 Mc on a specimen oriented along [0001], having a resistance ratio considerably in excess of 10,000 to 1. Standard ultrasonic techniques were employed. (C.E.S.)

9707 ALFVÉN-WAVE PROPAGATION IN PYROLYTIC AND SINGLE-CRYSTAL GRAPHITE. M. Surma, J. K. Furdyna, and H. C. Praddaude (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 13: 710-12 (Dec. 14, 1964).

Alfvén waves in pyrolytic and single-crystal graphite samples are studied at 4.2°K using a 35-Gc absorption cavity spectrometer, in magnetic fields of 0 to 14 kOe. The results include charge-carrier effective masses and densities, cyclotron resonance parameters, structure of the Alfvén-wave spectrum, and anisotropy of propagation of the waves. (T.F.H.)

9708 VOLUME SELF-DIFFUSION IN COBALT–NICKEL ALLOYS. A. Haessner and W. Lange (Technische Universität, Dresden). Phys. Status Solidi, 8: 77-91(1965). (In German)

The volume self-diffusion of ^{60}Co and ^{63}Ni in 11 Co–Ni alloys, with concentrations varying between 0 and 100 at. % Co, was investigated, by the residual activity method, in the temperature range from 1100 to 1416°C. The temperature dependence of the diffusion coefficient is described for all alloys by an Arrhenius equation. Extrapolation of the coefficient to the melting point gave, for all Co concentrations, a value of 5 to 7×10^{-9} cm^2/s. The dependence of the diffusion parameters on concentration in the range from 30 to 100 at. % Ni can be formally described by a simple equation. A theoretical justification of this equation was attempted using a vacancy model. Zener's theory of the activation entropy was verified for self-diffusion in pure metals. The change of activation entropy in the system was stronger than predicted by Zener, but the linear dependence between activation entropy and Q/T_m was fulfilled. (auth)

9709 AN ELECTRON GAS MODEL FOR THE LATTICE DYNAMICS OF BERYLLIUM. R. P. Gupta and B. Dayal (Banaras Hindu Univ., India). Phys. Status Solidi, 8: 115-22(1965).

The model originally proposed by Slutsky and Garland for the lattice dynamics of the hexagonal close-packed structure was modified by introducing the contributions of the electron gas. The latter were computed from the Cauchy discrepancy by following Sharma and Joshi's work on cubic metals. The force constants for beryllium were calculated, using this model, from the experimental data and one observed vibration frequency. The dispersion curves for the [0001] and $[0\bar{1}10]$ directions were computed and found to be in satisfactory agreement with the results of neutron scattering in beryllium. (auth)

9710 ISOPERIODIC VARIATION OF THE COMPRESSIBILITIES OF THE ELEMENTS. C. P. Kempter (Universität, Vienna). Phys. Status Solidi, 8: 161-72(1965).

It is shown that the compressibilities of solid elements may be systematically expressed as a function of atomic volume for a definite isoperiodic series. In the absence of pressure-induced discontinuities, such as a phase change, the isoperiodic relationships are independent of pressure. The following isothermal coefficients of volume compressibility ($\beta \times 10^7$ cm^2/kg at room temperature and one atmosphere) are predicted: α–Sc : ~ 20, Tc : 2.8, α–Tb : 28, Re : 2.7, Os : 2.7, α–Po : ~ 35, and if trivalent, Pm : 33. (auth)

9711 THE COMPRESSION OF AGGLOMERATED CARBON AT HIGH TEMPERATURE. G. Grémion and J. Marie (Société Le Carbone-Lorraine, Gennevilliers, France). Rev. Hautes. Temp. Refractaires, 1: 211-19 (July-Sept. 1964). (In French)

Among the most refractory materials C has the property of increasing in strength with increasing temperature. However, creep begins toward 2,500°C, and above that temperature the strength decreases rapidly. Compression of bonded C at 2,500° to 3,000°C alters properties so that the density increases by 10 to 20 p. 100, the open porosity decreases, the permeability becomes very low, the mechanical strength increases in the direction perpendicular to the compressive force by a factor of about two, and the electric resistivity decreases. The product thus obtained has improved properties compared with those of the original C. The application of this method to pyrocarbons makes it possible to obtain a plate of graphite that is highly orientated, the structure of which approaches that of a graphite monocrystal. (auth)

9712 CRYSTAL STRUCTURES OF SOME SCANDIUM ALUMINIDES. V. N. Rechkin, L. K. Lamikhov, and T. I. Samsonova (Chemico-Metallurgical Inst., Academy of Sciences, Siberian SSR). Soviet Phys.-Cryst. (English Transl.), 9: 325-7(Nov.-Dec. 1964). Translated from Kristallografiya, 9: 405-8(May-June 1964).

Results of microscopic and x-ray structural analyses of $ScAl_4$, $ScAl_3$, $ScAl_2$, and ScAl are presented. (J.R.D.)

9713 POLYMORPHISM OF ZIRCONIUM DICHROMIDE. S. P. Alisova, P. B. Budberg, and K. I. Shakhova (Baikov Inst. of Metallurgy, USSR). Soviet Phys.-Cryst. (English Transl.), 9: 343-4(Nov.-Dec. 1964). Translated from Kristallografiya, 9: 419-21(May-June 1964).

Results of an investigation are presented which show that $ZrCr_2$ exists in a high temperature form corresponding to the structure of $MgZn_2$ and a low temperature form corresponding to $MgCu_2$. The transformation temperature between the two forms is 1480 ± 10°C. (J.R.D.)

9714 THERMAL ETCHING OF BERYLLIUM CRYSTALS. I. I. Papirov and G. F. Tikhinskii (Physicotechnical Inst., Academy of Sciences, Ukrainian SSR). Soviet Phys.-Cryst. (English Transl.), 9: 371-3(Nov.-Dec. 1964). Translated from Kristallografiya, 9: 444-7(May-June 1964).

The effects of impurities on the thermal etch figures of Be crystals were investigated. In addition to Be single crystals, polycrystalline samples of Be, and Be alloys containing Fe, Ni, Ti, and Y were studied. An analysis of investigation findings is included. (J.R.D.)

9715 ELECTRICAL CONDUCTIVITY IN SOLID OXIDES. 7. SYSTEMS ThO_2–BeO, ThO_2–MgO, ThO_2–SrO, AND ThO_2–BaO. Z. S. Volchenkova and S. F. Pal'guev. Tr. Inst. Elektrokhim., Akad. Nauk SSSR, Ural'sk. Filial, No. 4, 67-81(1963).

The electric conductivity at 300 to 1000°C was studied in varying quantitative combinations (from pure ThO_2 to pure MeO) of these systems. Results indicated a slight solubility of BeO and MgO in ThO_2 and the formation of MgO · ThO_2. MeO-additions up to 15 mol % enhance the conductivity by approximately one order in the systems ThO_2–SrO and ThO_2–BaO, intensify the color of samples and cause their contraction, which suggests the possible formation of solid solutions. It was shown that the formation of $BaThO_3$ produces a deep linear contraction minimum during the thermal agglomeration of samples and produces a conductivity minimum. The considerable diminution of contraction and the course of the specific conductivity isotherms suggest the existence of the compounds $BaTh_3O_7$, $SrThO_3$, and Sr_2ThO_4 in the combinations 0.25 BaO · 0.75 ThO_2, 0.5 SrO · 0.5 ThO_2, and 0.7 SrO · 0.3 ThO_2. (auth)

9716 SECONDARY RECRYSTALLIZATION OF A HEAVILY WORKED TUNGSTEN WIRE. Hiroshi Yamamoto and Genichi Kamoshita (Hitachi Ltd., Tokyo). Trans. Japan Inst. Metals, 5: 204-5(July 1964).

A W wire was isochronally annealed in H_2 atmosphere and studied through its mechanical properties. Data on tensile strength and elongation at room temperature against the annealing temperature are presented along with curves showing tensile strength versus annealing time at various temperatures and a curve showing the kinetics of the secondary recrystallization. (J.R.D.)

9717 THE EFFECTS OF HEAT TREATMENT ON THE MAGNETIC PROPERTIES OF Fe–Al–Mo ALLOYS. Ichiro Morimoto and Hiroshi Maeda. Trans. Natl. Res. Inst. Metals (Tokyo), 6: 138-43(1964).

The effect of molybdenum on the Fe_3Al–FeAl phase transformation of Fe–Al alloys was studied by means of electric resistivity measurements at high temperatures, and magnetic properties of the alloys under conditions of various heat treatments were compared with the transformation process. The transformation temperature from the Fe_3Al phase increased at a rate of 17 to 18°C per molybdenum percent. The FeAl phase increased with the rise of temperature in the 400°C-transformation temperature regions, in which both FeAl and Fe_3Al phase exist, so that the magnetic properties increased with increasing quenching temperature. The best magnetic properties were obtained in water-quenching from temperatures above the transformation, in case of 0% molybdenum, but from temperatures about 50°C below it in cases of 3 to 4% Mo. More than 80% of the maximum values was obtained in water-quenching between 500 and 600°C. The magnetic properties decreased in order to form the Fe_3Al phase at quenching temperatures below 400°C in case of 0% molybdenum, but decreased slightly in cases of 2 to 4% Mo. This is believed to depend on the range of K and λ with molybdenum. (auth)

9718 COLD-ROLLING AND RECRYSTALLIZATION TEXTURES OF MOLYBDENUM SINGLE CRYSTALS. Panghsin Chou. Wu Li Hsueh Pao, 19: 297-305(1963).

The cold-rolling and recrystallization textures of molybdenum single crystals of (110) [001] and (111) [112] orientations after reduction in thickness of 70, 80, and 85% were investigated. It was observed that the changes of cold-rolling and recrystallization textures in both crystals are similar: it varies from 70 to 85% with the reduction in thickness the main texture component after cold-rolling is (111) [112], but the weaker texture components after cold-rolling changes from (110) [001] into (110) [001] + (210) [001]; the recrystallization texture also changes gradually from the (110) [001] + (221) [114] orientations into the (110) (001) + (320) (001) and (110) [001] + (210) (001) orientations similar to the change of the weaker texture components after cold-rolling. It is assumed that as the result of recrystallization *in situ* the recrystallization textures appears. After analyzing the rotation of the orientation of (111) [112] crystal in the process of cold-rolling caused by the alternative operations of different operative slip systems, the change of the weaker texture components after cold-rolling in both crystals with the increasing reduction can be explained satisfactorily. From this point of view the change of recrystallization textures with increasing reduction can also be explained. (Sci. Abstr. China, Math Phys. Sci. No. 4, 1963)

9719 FLUORITE MIXED PHASES OF THE DIOXIDES OF URANIUM, THORIUM, CERIUM, AND ZIRCONIUM WITH BISMUTH OXIDES. F. Hund (Anorganisch-Wissenschaftliches Laboratorium der Farbenfabriken Bayer AG, Krefeld-Uerdingen, Ger.). Z. Anorg. Allgem. Chem., 333: 248-55(Dec. 1964). (In German)

Methods of preparation, colors, lattice constants, and experimental and x-ray densities of fluorite-type mixed phases between bismuth(III) oxide and the dioxides of U, Th, Ce, and Zr are described. In the systems $UO_2-BiO_{1.5}$, $ThO_2-BiO_{1.5}$, and $CeO_2-BiO_{1.5}$, fluorite phases occurred from 0 to 100, 60, and 40 mole % $BiO_{1.5}$, respectively, with all cation positions being occupied and anion vacancies increasing with higher $BiO_{1.5}$ contents. In the system $ZrO_2-BiO_{1.5}$, the two-dimensionally ordered fluorite superstructure of $\beta-Bi_2O_3$ occurred from 30 to 100 mole % $BiO_{1.5}$. The pure $\beta-Bi_2O_3$ had an ideally occupied cation lattice and vacancies in the anion lattice, but at 40 mole % $BiO_{1.5}$ there was an ideally filled anion lattice with interstitial cations. (auth)

9720 ON THE OCCURRENCE OF Zr_2Cu- AND Cr_2Al-TYPE INTERMETALLIC COMPOUNDS. Aravamudhan Raman and Konrad Schubert (Max-Planck-Institut für Metall-FORSCHUNG, Stuttgart). Z. Metallk., 55: 798-804(Dec. 1964). (In German)

It was found by structural investigations that the alloy phases belonging to the Zr_2Cu branch or to the Cr_2Al branch of the $MoSi_2$ structure obey the following rules: the majority component of the Zr_2Cu type phases is usually a T^4 element and not a T^5 element. As minority component T^9, T^{10}, B^1, or B^2 elements may be found. The axial ratio c/a of the Zr_2Cu type phases was strongly influenced by the minority component. Different Zr_2Cu representatives generally formed uninterrupted series of solid solution. Representatives of the Zr_2Cu branch and the Cr_2Al branch did not form extensive solutions. The axial ratio of Cr_2Al was not influenced much by alloy formation. From this it was inferred, that both branches differ essentially in their bonding relation. (auth)

9721 PHASE ANALYSIS OF MAGNESIUM ALLOYS CONTAINING CERIUM AND NEODYMIUM. N. F. Lashko and G. I. Morozova. Zavodsk. Lab., 30: 1187-9(1964). (In Russian)

An electrolytic isolation of magnesium-rich phases from Mg–Ce and Mg–Nd alloys was achieved with 5 g sodium carbamate electrolyte in 1000 ml of methanol, at 0.03 a/cm³ and −5°C. Chemical and x-ray analyses of anodic precipitations showed isolated isomorphous compounds $Mg_{12}Ce$ and $Mg_{12}Nd$ with $Mn_{12}Th$ type crystalline structure. (tr-auth)

9722 STUDY OF THE PRASEODYMIUM–OXYGEN SYSTEM BY THE DIELECTRIC METHOD. G. Grosvald (CNRS, Rennes, France). p.398-401 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964. (In French)

The dielectric properties of praseodymium oxides were studied in the composition range $Pr_2O_3-PrO_2$ and beyond. The coexistence of two relaxation phenomena in the diphasic regions was observed. The regions' boundaries were in good agreement with those determined by other methods. Pr_6O_{11} was of some interest, its dielectric properties showed that oxygen vacancies in the PrO_2 structure are not altogether distributed at random. This result agreed with those attained by some authors using the x-ray-diffraction method. (auth)

9723 RECOVERY OF INTERNAL FRICTION OF MOLYBDENUM SINGLE CRYSTALS. P. L. Gruzin and A. N. Semenikhin. p.258-62 of "Relaksatsionnye Yavleniya v Metallakh i Splavakh." Moscow, Metallurgizdat, 1963.

Single crystals (SC) of Mo were grown from the vapor phase by thermal dissociation of molybdenum pentachloride. Intact SC (90 to 100 mm long) were cut from the crystal obtained which was 3 mm thick. The oxide of the crystal coincided with the [110] direction. The recovery of internal friction (IF) and modulus of elasticity E was examined in SC quenched at 1500 to 1600°C and then deformed. After measurement of IF and E, the hardened SC were subjected to plastic deformation by bending at room temperature. In hardened SC, the IF level is low and changes monotonically with temperature. After a 1% deformation, the IF level increases considerably. No recovery of initial IF and E was observed at room temperature. Upon heating to ~90°C IF does not change, and E decreases linearly with temperature. Beginning at 90 to 100°C, IF decreases rapidly, and at the same time E increases. Additional annealing at 600°C for 2 hr causes only a slight further decline in IF. A SC annealed at 600°C was subjected a second time to the same deformation as a quenched SC. The IF level rose markedly and E decreased appreciably, but these properties were not recovered on heating to 150°C. Neutron irradiation depresses the IF level in preannealed Mo SC. It is postulated that the recovery of IF and E values observed at 90 to 100°C is due to the stabilizing of free dislocations by vacancies in the quenched SC. (auth)

9724 CERAMIC MATERIALS FOR OPEN-CYCLE MHD POWER GENERATION. D. J. Dickson, R. W. Sanders, and A. C. C. Tseung (Central Electricity Generating Board, Leatherhead, Surrey, Eng.). 13p. (CONF-640701-81)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Ceramic material requirements for use in duct walls, air preheaters, and electrodes for magnetohydrodynamic generators are discussed, and tests of materials are described. (J.R.D.)

9725 MICROSTRUCTURAL CHANGES IN UO$_2$ FROM HEAT TREATMENT IN A TEMPERATURE GRADIENT. Hans Hausner. 13p. (CONF-553-10)

From American Ceramic Society 66th Annual Meeting Including Symposium on Nuclear and Space Applications, Chicago, Apr. 1964.

An investigation was made of microstructural changes in UO$_2$ from heat treatment in temperature gradients. The effects of time and central temperature on the development of the microstructure in a temperature gradient is shown schematically. After 2 hr, a small increase in grain size could be observed after heat treatments with a central temperature of 1900 and 2140°C, but the grains were still equiaxed. With a central temperature of 2400°C, formation of distinctive columnar grains took place after two hours. Very large columnar grains could be found after a heat treatment of 2600°C for the same length of time. In these grains large lenticular voids could be observed perpendicular to the direction of the temperature gradient. Every microstructural change occurred at a specific temperature. After heat treatment at 2850°C for 2 hr, the microstructure consisted of large crystals, which were extremely dense in contrast to the columnar grains formed below the melting point. Differences in the temperature gradient were found to have a significant influence on the UO$_2$ microstructure even when the central temperature remained constant. The formation of lenticular voids was suppressed when the temperature gradient was high enough. (M.C.G.)

9726 METALLOGRAPHIC OBSERVATION OF THE MONOCLINIC-TETRAGONAL PHASE TRANSFORMATION IN ZrO$_2$. L. L. Fehrenbacher and L. A. Jacobson (Air Force Materials Lab., Wright-Patterson AFB, Ohio). 31p. (CONF-553-11)

From American Ceramic Society 66th Annual Meeting Including Symposium on Nuclear and Space Applications, Chicago, Apr. 1964.

The monoclinic-tetragonal phase transformation of ZrO$_2$ was examined with a vacuum hot-stage microscope. Polished sections of vacuum-sintered ZrO$_2$ of 99.7% purity were observed from room temperature to 1300°C. The rapid formation of platelet substructure within ZrO$_2$ grains in the temperature range from 1050 to 1150°C was associated with the heating transformation. Photomicrographs and motion pictures were taken of the specimen as the transformation progressed. The surface deformation was irreversible, preventing observation of the phase inversion on cooling. It was concluded that the transformation is of the diffusionless, athermal type characteristic of Fe–Ni martensitic transformations. (auth)

Radiation Effects

Refer also to abstracts 10203 and 10565.

9727 (ARL-64-151) RADIATION EFFECTS IN SEMICONDUCTORS: (SUMMARY REPORT, JUNE, 1964). J. J. Loferski (Brown Univ., Providence). Oct. 1964. Contract AF33(657)-8974. 57p. OTS.

Range energy curves for these particles based on a critical review of the literature are presented. A circuit for stabilizing the output voltage and current of a Van de Graaff machine is described. The results of a calibration of the machine based on a p,γ reaction are presented. Radiation damage experiments in Ga–As based on studies of changes in recombination radiation induced by electron beam injection are described. An experiment is described which is designed to demonstrate the existence of a photovoltage between two parts of a semiconductor with different lifetimes, the lifetime difference having been produced by irradiation. (auth)

9728 (BAW-3376-1) IRRADIATION PERFORMANCE OF THORIA–URANIA FUEL MATERIALS. Quarterly Technical Report No. 1, May–September 1964. (Babcock and Wilcox Co., Lynchburg, Va.). Contract AT(30-1)-3376. 86p. Dep.; $3.00(OTS).

A research program is being conducted to establish, experimentally, physical properties of thoria-urania that are of interest to the reactor designer, and to present the physical property data in a form suitable for engineering application. The thermal conductivity and gas retention and release characteristics of sol-gel thoria–urania fuel will be emphasized. Pelletized fuel will be examined to standardize the experimental equipment and to provide data for correlation with available information. The major effort during this report period involved preparation of the work program and planning and design of the experiments. A literature survey of gas permeability studies is included. (D.L.C.)

9729 (CRT-1187(Pt.A)) THE AVERAGE NUCLIDE COMPOSITION IN IRRADIATED NATURAL URANIUM METAL FUEL RODS. S. A. Kushneriuk (Atomic Energy of Canada Ltd., Chalk River, Ont.). Sept. 1964. 48p. (AECL-2086) Dep.; $1.50(AECL).

A description is given of the basis for an approximate method of calculating the average nuclide composition and reaction rates in irradiated natural uranium metal rods. A summary is given of results of a calculation of the ^{235}U, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{242}Pu concentrations in a short length of a natural uranium rod (the NRX rod), irradiated in the NRX reactor, taking into consideration the variation of the neutron energy spectrum and nuclide composition with time and with position in the rod. Also listed is such auxiliary information as the average thermal neutron flux in the rod and the average effective cross section, which when combined with the average flux and average nuclide concentration gives the correct reaction rate. In the second section an approximate and simplified procedure for calculating the radial average nuclide concentrations in the rod, using the average effective cross sections directly, is outlined. For this purpose the cross sections are written in a Westcott-like form, and prescriptions for estimating the requisite components of the cross sections at different rod irradiations are given. The prescriptions are extracted directly from analysis of results of calculations, or are "analytically" derived approximations that reproduce those results well. (auth)

9730 (FZK-217) MEASURED EFFECTS OF THE VARIOUS COMBINATIONS OF NUCLEAR RADIATION, VACUUM, AND CRYOTEMPERATURES ON ENGINEERING MATERIALS. Quarterly Progress Report, May 1, 1964–September 30, 1964. E. E. Kerlin and E. T. Smith (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Oct. 30, 1964. Contract NAS8-2450. 73p.

A research program is being conducted to evaluate the combined effects of nuclear-reactor radiation and selected space-environment conditions on the engineering properties of organic materials. The space-environment conditions used in these tests were: (1) a vacuum of 10^{-6} torr, (2) cryotemperatures of liquid N_2 and H_2, and (3) a combination of vacuum and cryotemperature. The following information is given for the 1964-65 test program: (1) a listing of the test materials selected, (2) detailed background information on these materials, (3) proposed radiation exposures and environmental conditions, (4) applicable ASTM evaluation tests, and (5) details on modifications planned for special test equipment to be used in the program. Specimens scheduled for testing in air will be tested in a standard Instron tensile tester. Specimens scheduled for testing in the vacuum or cryogenic environments will be tested with special equipment developed at NARF and MSFC. The measurements to be made in evaluating the effects of the combination environments on the materials are lap-shear strength, ultimate elongation, stress-strain characteristic, flexural strength, compressive strength, thermal conductivity, and lubricity. (D.L.C.)

9731 (GA-5273) EFFECTS OF IRRADIATION ON A-302B STEEL SUBJECTED TO A MULTIAXIAL STRESS DISTRIBUTION. T. A. Trozera and P. W. Flynn (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Oct. 12, 1964. Contract AT(04-3)-167. 23p. (CONF-512-15). Dep.(mn); $1.00(cy), 1(mn) OTS.

From American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964.

Tests were made on irradiated tube specimens at a fixed ratio (unity) of principal stresses over a range of temperatures. Supporting tests were also made on tension and Charpy-impact specimens irradiated to the same level. Neutron doses ranged from 1.6×10^{18} to 1.14×10^{20} nvt. The results are presented in the form of effective stress-effective strain curves. Considére's geometrical construction for predicting the maximum load was found to be applicable to irradiated tensile specimens where the yield point is followed by some uniform elongation. The uniform strain for tube specimens with equal biaxial stresses was much less than that in a solid tensile bar. (D.L.C.)

9732 (GEAP-4596) THE RELEASE OF FISSION GASES FROM URANIUM DIOXIDE PELLET FUEL OPERATED AT HIGH TEMPERATURES. J. P. Hoffmann and D. H. Coplin (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 1964. Contract AT(04-3)-189. 28p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Pelleted UO_2 fuel rods, of comparable designs and fabrication histories, were irradiated at peak surface heat fluxes ranging from 63 to 440 w/cm^2 (200,000 to 1,400,000 Btu/hr-ft^2). The values of average burnup for the different rods tested ranged from 0.03 to 3×10^{20} fissions/cc of UO_2 (100 to 11,000 Mwd/tu). After irradiation, the free fission gases contained in each rod were collected and the quantity of released gas was related to a calculated value of the gas generated during the lifetime of the rod. The percentages of fission gas released were plotted as a function of the volumetric average temperature of the respective fuel rods at the peak power experienced during their periods of reactor exposure. It was found that percent release gradually increased with temperature, and that 50 to 60 percent of generated fission gases escaped to the free volume of a fuel rod when exposed at heat fluxes high enough to produce gross melting of UO_2 in the center of the fuel column. From these data, the following significant observations were made: 1) In the range of interest for power reactor applications, 800 to 1400°C volumetric average temperature, none of the gas release was greater than 50 percent. Furthermore, most of the data fell in a range of 2 to 30 percent. 2) Under gross center melting conditions, e.g., 35 percent of the fuel volume molten, a maximum release of approximately 60 percent was observed. 3) Within the range of study, the level of burnup attained by the fuel appeared to have no effect on fractional fission gas release. The lack of burnup dependence in the fission gas release data is most likely caused by the large temperature-dependent gas releases masking the small amount of low-temperature time-dependent gas release. (auth)

9733 (GNE-Phys/64-1) LENGTH-CHANGE MEASUREMENTS OF ELECTRON-IRRADIATED CADMIUM SULFIDE (thesis). Ronald Lawrence Bellows (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1964. 93p. (AD-603606). $3.00(OTS).

The relationship between radiation damage in a "thin" platelet, high purity, single-crystal cadmium sulfide crystal and the change in the physical dimensions of the crystal was investigated. The sample was irradiated in a vacuum at 77 and 300°K by a 150-kev electron beam just above the beam displacement threshold for the sulfur atom of 115 kev. The shrinkage and its ultimate saturation suggest the diffusion of sulfur interstitials from the crystal with an accompanying accumulation of sulfur vacancies in the lattice. The difference in the results at 77 and at 300°K indicates an annealing of the damage somewhere between the two temperatures. (auth)

9734 (LA-DC-6713) UHTREX FUEL IRRADIATIONS. P. J. Peterson (Los Alamos Scientific Lab., N. Mex.). Oct. 7, 1964. Contract W-7405-eng-36. 12p. (CONF-641111-3). Dep.(mn); $1.00(cy), 1(mn) OTS.

From US-Japan Information Exchange Meeting on Ceramic Nuclear Fuels 19th High Temperature Fuels Committee Meeting, Canoga Park, Calif.

Two extruded UHTREX fuel elements loaded with pyrocarbon-coated UC_2 beads were irradiated in capsules at 1320 to 1520°C for 229 hr and an estimated burnup of 1.0% of the ^{235}U. Measurements of the dimensions, length, weight, density, capsule gas, and Xe isotopes are given. Results of metallographic examination of the irradiated fuel are described. A study was made of the ^{133}Xe release from postirradiation heating of beads and extruded elements. The results showed that bead damage was occurring during the postirradiation heating. The ^{133}Xe release from the elements is an order of magnitude less than from the beads. The possibility of bead and element damage by H_2O corrosion is discussed. (D.L.C.)

9735 (NRL-Memo-1424) IRRADIATION EFFECTS ON STRUCTURAL MATERIALS. Quarterly Progress Report, February 1–April 30, 1963. L. E. Steele, J. R. Hawthorne, and H. E. Watson (Naval Research Lab., Washington, D. C.). May 15, 1963. 15p. (AD-420048). $3.60 (OTS).

This report includes the following: (1) a summary review of the data on neutron embrittlement for the several steels studied, (2) the effects of very high neutron dosage on two steels, (3) the effects of various heat treatment conditions as well as cyclic irradiation-annealing treatments on the notch ductility properties of irradiated steels, (4) the calibration of the in-cell Charpy impact machine, and (5) the results of a shielding efficiency survey of the cells in the new Metallurgy High Level Radiation Laboratory. (auth)

9736 (REIC-ACCESS-82) MONTHLY ACCESSION LIST [ON RADIATION EFFECTS DATA]. Abstract No. 25763 to 25816. (Battelle Memorial Inst. Radiation Effects Information Center, Columbus, Ohio). Jan. 10, 1965. Includes MONTHLY ACCESSION LIST COORDINATE INDEX. Accession Lists from October 1, 1964 to December 31, 1964. Contracts W-7405-eng-92 and AF33(615)-1124. 33p. Dep.(mn); $2.00(cy), 1(mn) OTS.

A total of 54 abstracts are presented for articles accessioned and extracted for the REIC Technical Information File during the period Dec. 1 to 31, 1964. The abstracts are arranged according to materials (metallic, ceramic, organic, polymeric, inorganic, electronic), electronic components, facilities, space environment effects, experimental devices and techniques, and miscellaneous. (D.L.C.)

9737 (UJV-1145/64) VLIV NEUTRONOVÉHO ZÁŘENÍ NA VLASTNOSTI BORALU. (Effects of Neutron Irradiation on Boral Properties). V. Rubeš and M. Vacek (Československá Akademie Věd. Ústav Jaderného Výzkumu, Řež). 1964. 16p. Dep.(mn).

The effects of thermal neutron irradiation on the tensile properties, hardness, and stability of boral were studied, with boral specimens exposed to integral doses of 4×10^{18} to 7.4×10^{18} n/cm^2. (R.V.J.)

9738 (VDDIT-16(4.3)) RADIATION EFFECTS ON SOLID, URANIUM-BASED NUCLEAR FUEL MATERIALS. Vol. 4, No. 3. A Bibliography. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Nov. 1964. 96p. Dep.(mn).

A total of 84 abstracts with references is presented on metallic U, alloys, carbides, ceramic oxides, nitrides, dispersion fuels, and coated-particle fuels. Subject, coordinate, publication, and corporate author indexes are included. (D.L.C.)

9739 (VDDIT-16(4.4)) RADIATION EFFECTS ON SOLID, URANIUM BASED NUCLEAR FUEL MATERIALS. VOLUME 4, NUMBER 4. A Bibliography. W. Uhlmann (Aktiebolaget Atomenergi, Stockholm). Dec. 1964. 124p. Dep.(mn).

A total of 93 abstracts are presented on metallic U, alloys, carbides, oxide ceramics, nitrides, dispersion fuels, and coated-particle fuels. Subject, publication, and corporate author indexes are included. (D.L.C.)

9740 (EURAEC-1094) NEW RESULTS CONCERNING THE BEHAVIOR OF FISSION GASES IN IN-PILE UO_2 AT HIGH TEMPERATURES. Special Report No. 9. Albert Schurenkamper (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy) and René Soulhier (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 031-60-10-RDF. 61p. Translation of CEA-R-2588. Dep.(mn); $3.00(cy), 2(mn) OTS.

A discussion is given of the various phenomena giving rise to the production of fission gases towards the exterior of nuclear fuels. The following aspects are dealt with: diffusion, for which is considered the influence of the predecessors of the radioactive gases, fission recoil, atom expulsion along the fission paths, and evaporation. Results are presented for UO_2 samples subjected to irradiation at temperatures of between 150 and 2000°C. At low temperatures the variation of the amount produced as a function of the half life of the isotopes studied shows that recoil is not the only cause of gas production. Above 1800°C, a weight loss by evaporation has been observed and the influence of this phenomenon on gas liberation has been studied; thus the fraction of ^{135}Xe liberated at 2000°C by processes other than evaporation is of the order of 10 per cent. The influence of the various mechanisms on the overall effect as a function of temperature is discussed. (auth)

9741 THE EXTRAPOLATION OF GRAPHITE GROWTH DATA TO HIGH DOSES. G. K. Williamson and P. Horner (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc., 3: 269-75(Oct. 1964).

An extrapolation method for graphite growth data is presented. This is considered more realistic than earlier methods in that it allows for variation of the effectiveness of interstitials with temperature as well as the numbers surviving. This extrapolation predicted simple behavior without large curvatures and satisfactorily predicted the observed behavior of US graphite at high doses. It was easy to visualize the effects on predictions of errors in the assumption made. The major uncertainty in the predictions arose because the detailed shape of the growth/dose curve for single crystals had to be inferred from low-temperature data; these data were themselves uncertain at high damage levels and were known to overestimate the effects. A formal method of correcting for this uncertainty was devised and in the absence of precise crystal data, it is shown that irradiation to about half a reactor lifetime is required to determine the approximate saturation level of the growth effects. (auth)

9742 MEASUREMENT OF THE EMISSION OF LOW-ENERGY ELECTRONS IN AN IRRADIATED VACUUM CAVITY CHAMBER. T. E. Burlin and S. R. Husain (The Polytechnic, London). Nature, 204: 1078-8(Dec. 12, 1964).

The magnitude of slow electron emission from a gamma-irradiated Cu surface was measured directly in vacuum. Equipment and procedures used in the measurements are described. A value of 0.93×10^6 electrons/cm^2/rad for low-energy electron emission from the Cu surface was obtained. (J.R.D.)

9743 MAGNETIC PROPERTIES OF RADIATION-DAMAGED LiF. T. W. Adair, III, and C. F. Squire (Texas Agricultural and Mechanical Univ., College Station). Phys. Rev., 137: A949-51(Feb. 1, 1965).

A right circular cylinder of a large single crystal of LiF was hung along its axis of symmetry to form a sensitive torsion pendulum. In a uniform magnetic field a torque was observed to act on the pendulum, which was interpreted as arising from lattice defects caused by soft x radiation. Quantitative studies on the frequency of oscillation as a function of magnetic field orientation to the LiF crystal are reported. (auth)

9744 PHENOMENOLOGICAL INTERPRETATION OF EXPERIMENTS ON THE MAGNETIC PROPERTIES OF RADIATION-DAMAGED LiF. J. L. Gammel (Texas Agricultural and Mechanical Univ., College Station). Phys. Rev., 137: A951-2(Feb. 1, 1965).

The experimental observations by Adair and Squire have a reasonable phenomenological interpretation. There is a quantitative agreement between theory and experiment. The magnetization due to radiation damage exhibits a residual value in zero external field and is described by a susceptibility tensor with off-diagonal terms in the presence of a magnetic field. (auth)

9745 RECOMBINATION OF VACANCIES AND INTERSTITIALS IN KBr AT LOW TEMPERATURES. N. Itoh, B. S. H. Royce, and R. Smoluchowski (Princeton Univ., N. J.). Phys. Rev., 137: A1010-15(Feb. 1, 1965).

Measurements and a detailed analysis were made of the thermal annealing of the α band in KBr x rayed at temperatures below 20°K. Four distinct annealing stages at 11, 17, 19, and 21°K were resolved, the first three stages corresponding to first order reactions and the fourth stage to a second order reaction. The activation energies for the annealing stages were about 0.015, 0.03, 0.04, and 0.06 ev, respectively. The first three stages were interpreted as a correlated recombination of close pairs of bromide vacancies and interstitials, and the fourth stage as the recombination of more distant defect pairs through a free migration of an interstitialcy. The activation energy 0.06 ev is interpreted as the free migration energy of a bromide-ion interstitialcy. Interaction energies between a vacancy and an interstitial ion in several configurations were calculated and possible annealing sequences for the first three annealing stages are proposed. The observed low pre-exponential factor for the first stage is also discussed. (auth)

9746 PROTON BOMBARDMENT DAMAGE IN SILICON. R. Bubáková and Z. Szmid (Inst. of Solid State Physics, Czechoslovak Academy of Sciences, Prague and Inst. of Nuclear Research, Warsaw). Phys. Status Solidi, 8: 105-14(1965).

An x-ray study was made of a single crystal of Si after irradiation by protons at an energy $\simeq$ 6.5 Mev. The total dose was 1 to 2×10^{16} protons/cm^2. An increase of the lattice parameter: $\Delta a \simeq + 3 \times 10^{-5}$ Å was observed after bombardment. The atomic planes in the bombarded part of the Si crystal were tilted, making an angle of 1.7″ with planes of the unbombarded part. An imperfection in the diamond-type structure was found as confirmed by diffraction from the (222) planes. (auth)

9747 EFFECT OF ELECTRON IRRADIATION ON THE MAGNETORESISTANCE OF InSb. P. C. Euthymiou (Univ. of Athens). Phys. Status Solidi, 8: 131-8(1965).

Samples of n- and p-type InSb were irradiated by 1-Mev (average energy) beta particles at low temperatures. For the n-type material the radiation damage resulted in a small increase in electron concentration. This was not in agreement with other investigations. The Hall mobility was found to decrease as expected. From the resistivities ρ_0 and ρ_B (without and with a magnetic field) and the concentration n of electrons the constant A of the formula $\sigma_B = \sigma_0\,[1 - A(B \cdot \sigma_0/n \cdot e)^2]$ in Wilson's theory was determined. Before irradiation the n-type sample ($n = 1.047 \times 10^{15}$ carriers/cm^3 at T = 78°K) was found to have A = 0.0376, which indicated mixed scattering. Upon irradiation at 78°K, A increased to the value 0.0403, which can be explained by the increased importance of the scattering from ionized defects. For p-type material the radiation damage resulted in an increase of hole concentration and a decrease in Hall mobility. This was in agreement with other investigations. Before irradiation the p-type sample ($p = 4.47 \times 10^{14}$ carriers/cm^3 at T = 90°K) was found to have A = 3.27. This was larger than the largest theoretical value 2.12, calculated for the case where scattering from ionized defects was predominant. Upon irradiation at 78°K the p-type sample was found to have A = 4.13. Annealing experiments done on both the crystals showed that A tends to return to its initial value. (auth)

9748 ELECTRON SCATTERING IN InSb. I. M. Tsidilkovski (Inst. of Metal Physics, Academy of Sciences, Sverdlovsk, USSR). Phys. Status Solidi, 8: 253-60(1965).

Measurements and theoretical analyses of a number of transport effects in n-type InSb for a variety of impurity concentrations and $T > 77°K$ were examined. The problem of electron scattering was chiefly studied. The contribution of different scattering processes was found to be dependent on temperature and impurity concentration. It is emphasized that acoustic phonons cannot be neglected in this respect. (auth)

9749 DEFECT DISTRIBUTION IN DISPLACEMENT CASCADES. III. NOBLE METALS. R. v. Jan (Max-Planck-Institut für Metallforschung, Stuttgart and Technische Hochschule, Stuttgart). Phys. Status Solidi, 8: 331-44(1965). (In German)

Application of the cascade theory to the noble metals copper, silver, and gold is discussed. In all three metals pronounced vacancy zones occurred. At higher primary energies ($Cu \gtrsim 2$ kev, $Ag \gtrsim 5$ kev, $Au \gtrsim 10$ kev) the vacancy zones split into several small zones, which were embedded in a "cloud" of interstitial atoms. Typical cascades produced by reactor irradiation had diameters of about 80 Å (Au), 100 Å (Ag), and 200 Å (Cu). They probably contained a single vacancy zone in the case of gold, and several such zones in the cases of silver and copper. Theories on the damage by reactor irradiation were confirmed by a comparison with measurements of the critical shear stress, and allowed a simple explanation of the different behavior of these metals during recovery of the electric resistivity. (auth)

9750 ON THE SIGNIFICANCE OF LOW-TEMPERATURE ELECTRON IRRADIATION OF METALS. II. KINETICS OF THE CROWDION-VACANCY ANNIHILATION AND THE RECOVERY STAGE I_E IN COPPER. W. Frank, A. Seeger, and G. Schottky (Max-Planck-Institut für Metallforschung, Stuttgart and Technische Hochschule, Stuttgart). Phys. Status Solidi, 8: 345-56 (1965). (In German)

Metastable interstitial atoms, which diffuse only along definite straight lines (crowdions) were proposed as a model for the damage induced by electron bombardment in copper. These straight lines contain the vacancies that the crowdions leave behind them. A theoretical investigation was made of the kinetics of crowdion diffusion to these vacancies and to statistically distributed ones left by other crowdions. The conversion of metastable crowdions to the dumb-bell configuration was also taken into account. It is shown that the recovery kinetics, observed by Corbett *et al*., in stage I_E, of the additional electrical resistivity produced by electron irradiation of copper can be explained quantitatively by the superposition of an annihilation of free mobile crowdions at vacancies and a transformation of crowdions into dumb-bells. The remaining substages of stage I in electron irradiated copper are caused mainly by the recombination of close dumb-bell vacancy pairs. In stage I_D, annealing of correlated crowdion-vacancy pairs plays an important role. (auth)

9751 AUTOMATIC TORSION PENDULUM FOR THE CONTINUOUS RECORDING OF INTERNAL FRICTION AT CONSTANT AMPLITUDE AND VERY LOW FREQUENCIES. A. Salvi, D. Dautreppe, and E. Friess (Centre d'Etudes Nucléaires, Grenoble, France). Rev. Sci. Instr., 36: 198-201(Feb. 1965).

A torsion pendulum of the inverted type is maintained in oscillation at constant amplitude by means of an electric device. The mechanical oscillation gives rise to a frequency modulation which is detected in an original demodulator. The signal is amplified and used to supply two driving coils acting on small permanent magnets mounted on the inertia member. The amplifier is controlled by an error signal coming from the comparison of the amplifier input signal and a reference. An example of record showing internal-friction peaks in neutron-irradiated iron is shown. (auth)

9752 EFFECTS OF PHYSICO-CHEMICAL CONDITIONS ON RADIATION DEFECTS INFLICTED IN ELECTRON MICROSCOPIC OBJECTS. I. G. Stoyanova and T. P. Martynenko. Zavodsk. Lab., 30: 1470-3(1964). (In Russian)

Radiation defects inflicted on materials being investigated by electron microscopes were studied, considering the physicochemical conditions. Dimensions of the irradiated area, the time of exposure, and variations in defects during the post-exposure time are discussed. It was found that greater defects were caused by irradiation in a vacuum (10^{-4} mm Hg). The damage also depended on the diameter of the exposed area and on the dosage. (R.V.J.)

9753 EFFECT OF RADIATION ON THE STRUCTURE AND TENDENCY TOWARDS THERMAL DECOMPOSITION OF CHROME CEMENTITE. V. A. Shalashov (Inst. of Textile Mechanical Equipment, USSR). Zh. Fiz. Khim., 38: 2735-7(Nov. 1964). (In Russian)

An x-ray analysis indicated a strong radioresistance of chromium cementite (electrolytically separated from white iron), with 1.75% Cr, subjected to radiothermal treatment at 70 to 700°C. Radiothermal treatment may also be used as a method for determining metastability of alloyed and nonalloyed cementite. (R.V.J.)

9754 THE EFFECT OF GAMMA- AND NEUTRON RADIATION ON THE INTERNAL FRICTION OF COPPER. A. A. Vasilev, P. L. Gruzin, Yu. D. Zharov, Yu. A. Polikarpov, Yu. A. Trokin, A. Kh. Breger, and V. A. Goldin. p.250-7 of "Relaksatsionnye Yavleniya v Metallakh i Splavakh." Moscow, Metallurgizdat, 1963.

Irradiation of Cu specimens with gamma-rays, neutrons, and in nuclear reactors is reported. Internal friction was measured with bending vibrations on a Ferster device in the interval from -196 to $+200°C$. Polycrystalline specimens of electrolytic Cu and monocrystals of specially pure Cu type V3 were annealed in a vacuum at 800°C for 3 to 4 hours. Pre-deformation of the specimens of approximately 10^{-3} greatly increases the level of internal friction. Subsequent radiation of the specimens with neutrons results in a decrease of internal friction by one-half. Annealing at 200°C for 3 hr lowers the level of internal friction to the original value. Investigation of the temperature dependence of internal friction was made in the amplitude independent region. The conclusion is made that the observed peaks on the temperature relation curves are not Bordon peaks, are independent of the level of deformation, and have a high activation energy. Possibly, the cited peaks are due to impurities. (auth)

METEOROLOGY

9755 (HASL-153) FLIGHT DATA AND RESULTS OF RADIOCHEMICAL ANALYSES OF FILTER SAMPLES COLLECTED DURING 1961 AND 1962. Appendix to the Tenth Progress Report on Project Star Dust. Herbert W. Feely, James P. Friend, Philip W. Krey, and Barbara A. Russell (Isotopes, Inc., Westwood, N. J.). Aug. 1, 1964. Contract DA-49-146-XZ-079. 220p. $3.00(OTS).

In Project Star Dust, a study of gaseous and particulate matter in the upper atmosphere, a model of atmospheric transport processes is being developed. Results are presented of the radiochemical analyses of stratospheric and tropospheric air filter samples collected during the project. The radionuclides which were determined include the fission products (^{90}Sr, ^{89}Sr, ^{95}Zr, ^{144}Ce, ^{141}Ce), short-lived fission products (^{140}Ba, ^{131}I, ^{99}Mo), ^{137}Cs and ^{239}Pu, tracer nuclides (^{181}W, ^{102}Rh, ^{7}Be, ^{210}Pb, ^{210}Po), neutron activation products (^{54}Mn, ^{55}Fe, ^{124}Sb, ^{125}Sb, ^{57}Co, ^{204}Tl, ^{59}Fe, ^{58}Co), ^{109}Cd, ^{113m}Cd, and ^{185}W. (D.L.C.)

9756 (TO-B-64-10) STUDY OF BOMB DEBRIS EFFECTS. VOLUME I. THE TECH/OPS TWO-DIMENSIONAL TIME-DEPENDENT HYDRODYNAMICS CODE. APPLICATION TO SHOCK INTERACTION STUDY, 1962–1963. Final Report. Martin D. Torrey and Melvin R. Rubin (Technical Operations Research, Burlington, Mass.). Feb. 14, 1964. Contract DA-19-020-ORD-5408. 89p. (AD-601585) $2.25(OTS).

The Tech/Ops two-dimensional, time-dependent hydrodynamics FORTRAN code for IBM 7090 or 7094 computers was modified to simulate the interaction between a re-entry vehicle and the shock wave from a nuclear burst at intermediate altitude. The simulation method requires that the calculations be able first to describe axially symmetric steady flow about an obstacle. Modification of the code to provide steady-flow solutions on the IBM 7090/7094 computer and subsequent application to the shock interaction problem are described and demonstrated below. A streamline program for displaying and utilizing the results is included. (auth)

9757 AEROSTATIC INVESTIGATIONS OF RADIATION BALANCE OF THE EARTH SURFACE–ATMOSPHERE SYSTEM. K. Ya. Kondrat'ev, G. N. Gaevskaya, and G. A. Nikol'skii. Kosmich. Issled., 1: 448-59(Nov.-Dec. 1963). (In Russian)

Vertical profiles of radiation balance and radiation components during summer and fall were measured using standard actinometric devices installed in a free aerostat. (tr-auth)

9758 RADIOACTIVE STRONTIUM CONTENT OF RAINFALL. E. Bakács-Polgár and I. Kurcz-Csiky (State Inst. of Hygiene, Budapest). Nature, 204: 1057-9(Dec. 12, 1964).

Results of rainfall analyses for Sr during the period Oct. 1962 through Dec. 1963 are presented. It is noted that since the aim of the investigation is to examine the monthly average values, the chemical separation process is shortened by omission of 12.8-day Ba separation. Data are included on total beta activities and the monthly averages of ^{89}Sr–^{90}Sr. (J.R.D.)

9759 TRANSPORT AND DEPOSITION OF CONTAMINATION FROM AN INSTANTANEOUS SOURCE. E. M. Wilkins and T. Johnson. 22p. (CONF-555-6)

From International Symposium on Surface Contamination, Gatlinburg, Tenn., June 1964.

Diffusion from an instantaneous point source is formulated, based upon a Gaussian distribution within the cloud and the similarity theory of turbulence. In this development ϵ, the rate of dissipation of kinetic energy per unit mass, operates as a diffusion parameter. A discussion is given of how ϵ varies with altitude and atmospheric stability, and how ϵ may be measured. The total dose and deposition integrals of the Gaussian cluster are given. Comparisons are made with previously reported data. It was concluded that the similarity theory offers a practical approach to analysis of diffusion from an instantaneous source. (auth)

PHYSICS

General

Refer also to abstracts 8722 and 9049.

9760 (AD-602470) THE SECOND ORDER SUSCEPTIBILITY TERMS IN ORTHOFERRITES AT ROOM TEMPERATURE. Technical Note No. 2. G. Gorodetsky and D. Treves (Weizmann Inst. of Science, Rehovoth, Israel). Sept. 15, 1963. Contract AF61(052)-654. 22p. $1.00 (OTS).

Two possible mechanisms for weak ferromagnetism, single ion magnetocrystalline anisotropy, and antisymmetric exchange are examined on orthoferrites which contain a paramagnetic rare earth. The study was done by comparing the ferromagnetic components and the terms of the second order susceptibility tensor that are obtained from torque measurements to the equivalent values calculated from hamiltonians based on above mechanisms. The results show that the weak ferromagnetism is due mainly to the antisymmetric exchange mechanism. (auth)

9761 (AFCRL-64-534) DYNAMIC NON-LINEAR WAVE PROPAGATION IN IONIZED MEDIA. 15. ČERENKOV EFFECT IN A PREOSCILLATING MEDIUM. Research Report No. 46. K. H. B. Wilhelmsson and A. R. Thomasson (Chalmers Tekniska Högskola, Göteborg. Forskningslaboratorium för Elektronik). Apr. 1, 1964. Contract AF61(052)-451. 22p. (AD-602970) $1.00(OTS)

It is shown that for a pre-oscillating medium, i.e. a medium that oscillates in time and space even in the absence of a Čerenkov electron, side-bands of the original Čerenkov radiation spectrum will be generated. The characteristics of the associated waves are determined. Utilization was made of classical electrodynamics to solve the problem and express the disturbance in the medium by a propagating term in the dielectric constant describing the medium macroscopically. (auth)

9762 (AID-P-64-44) NUCLEAR WEAPONS EFFECTS—COMPILATION OF ABSTRACTS. (Library of Congress. Aerospace Information Div., Washington, D. C.). July 1, 1964. 26p. (AD-602358). $2.00(OTS).

Thirty-one abstracts of Soviet papers (published between Jan. 1956 and Mar. 1964) are given under the following headings: Structure and parameters of strong shock waves in gases; Parameters of strong shock waves in solids; Propagation of strong shock waves; Interaction of strong shock waves with materials; Nuclear explosion effects; The meteorite analogy; Radiative heat transfer. (auth)

9763 (ARL-63-195) DAMPING AND POLARIZATION OF PLANE MAGNETOHYDRODYNAMIC WAVES. S. I. Herlitz (Uppsala Univ. Inst. of Physics). Jan. 1963. 17p. (AD-420544) $1.60(OTS)

The influence is studied of resistive dissipation on the properties of plane, time-harmonic, small-amplitude magnetohydrodynamic waves in a compressible fluid immersed in a homogeneous magnetic field. As the electrical conductivity decreases from infinity to zero, either the fast or slow magnetoacoustic wave transforms to an ordinary sound wave. The description of this transition depends on whether the Alfven speed is less than, equal to, or greater than the sound speed. The fluid displacement in the fast and slow waves is, in general, elliptically polarized in a plane parallel to the magnetic field and the wave normal. In some cases the dissipation may have a considerable effect on the polarization of a wave, even though the wave is relatively weakly damped. (auth)

9764 (ARL-63-196) NONLINEAR DISTORTION OF PERIODIC MAGNETOHYDRODYNAMIC WAVES. S. I. Herlitz (Uppsala Univ.). Aug. 1962, Revised Mar. 1963. 9p. (AD-420545) $1.60(OTS).

A method for calculating the frequency spectrum of a nonlinearly distorted, time-periodic sound wave, is generalized slightly and applied to nonlinear magnetohydrodynamic waves. Two examples are considered. The first, a longitudinal wave propagating across a magnetic field, is closely analogous to an ordinary sound wave. The second example is a nonlinear generalization of a plane-polarized Alfven wave; it is shown that odd overtones develop in the transverse component of the magnetic field. (auth)

9765 (CEA-R-2448) UN CALCULATEUR ANALOGIQUE SIMPLE POUR RESOUDRE L'EQUATION INTEGRALE D'ABEL. (Simple Analog Computer for Solving the Abel Integral Equation). Lothar Becker and Hans-Werner Darwin (France. Commissariat à l'Énergia Atomique. Centre d'Etudes Nucléaires, Fontenay-aux-Roses). Aug. 1964. 21p. (EUR-1806f) Dep.(mn)

A special, very simple analog computer is described which permits a rapid and direct calculation of the radial distribution of the emission coefficient of an axial symmetrical discharge column from "side-on" observed light intensities. Different values of the emission coefficient can be obtained for arbitrarily radial distances without beginning at the edge of the column or at the wall of the discharge tube. The computer is very easy to handle. The precision obtained with apparatus is shown using some practical examples. (auth)

9766 (COO-623-105) SOLID-STATE PHYSICS PROGRAM ANNUAL PROGRESS REPORT, NOVEMBER 1963–OCTOBER 1964. (Case Inst. of Tech., Cleveland). Nov. 1, 1964. Contract AT(11-1)-623. 20p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Research activities in progress on solid-state physics are summarized. Information is reported on thin film physics, cohesive properties of crystals, and solid-state theory. (N.W.R.)

9767 (IS-900(Sect.P)) PHYSICS DIVISION. (Ames Lab., Ames, Iowa). 72p.

Progress is reported in solid state physics, high energy physics, and low energy nuclear physics. (J.R.D.)

9768 (LAMS-3079) RECENT PROGRESS IN TRANSPORT THEORY. G. I. Bell, B. G. Carlson, and K. D. Lathrop (Los Alamos Scientific Lab., N. Mex.). Apr. 30, 1964. Contract W-7405-eng-36. 37p. Dep.(mn); $2.00 (cy), 1(mn) OTS.

Condensed Version in NSA, 18: 32709 from A/CONF.28/P/261.

A brief review is given of efforts to broaden the theoretical base of neutron and photon transport, including: systematic derivation of a transport equation from the formalism of quantum field theory using coarse-grained density distributions; use of probability generating functions together with first collision equations to formulate a stochastic theory of neutron transport, including arbitrary deviations from the mean; and invariant imbedding methods wherein the usual Boltzmann or transport equations with conditions at two boundaries are replaced by non-linear equations with conditions at a single boundary. Achievements in the classical analysis of the transport equation and related linear integral equations are considered. The properties of the spectrum of eigenvalues of the transport operator are reviewed, and the method of expanding general solutions in terms of a complete set of eigenfunctions is outlined. Extensions of the eigenfunction expansion method from plane to curved geometries, from isotropic to more general scattering laws, and from monoenergetic to energy-dependent problems are sketched. Limitations and potential extensions of the method are noted. Developments in variational methods are summarized, including methods yielding a result with an error of high order in the trial function error. Numerical methods are also reviewed. The generalized discrete ordinates multi-group method is first discussed beginning with formulation of integral equations, called mesh cell balance equations. Various simplifications are considered in this framework. Developments in spherical harmonics and other polynomial methods are traced, including the use of Tschebyscheff and Gegenbauer polynomials. The use of partial range orthogonal polynomials is outlined, and a polynomial approach, the generalized method of moments, is presented. A detailed summary of the S_n method is given and source term treatments including anisotropic scattering are evaluated. (auth)

9769 (NYO-2150-3) MACROSCOPIC THEORY OF HELICONS (thesis). Report No. 214. Charles Rudolf Legendy (Cornell Univ., Ithaca, N. Y. Materials Science Center). June 1964. Contract AT(30-1)-2150. 74p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Several problems in the theory of helicons are posed and solved. Helicons are solid-state magneto-plasma oscillations that obey the same equations as atmospheric radio whistlers. Helicon proper modes are investigated. (T.F.H.)

9770 (NYO-2391-6) THERMAL CONDUCTIVITY OF INSULATING CRYSTALS IN THE PRESENCE OF NORMAL PROCESSES. J. A. Krumhansl (Oxford Univ.). Nov. 1964. Contract AT(30-1)-2179. 27p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The problem of computing the phonon distribution and thermal conductivity in the presence of N-processes is examined in the framework of the Boltzmann-Peierls' equation. A heat flow may be associated with drift and diffusive distributions respectively; this intuitive concept is given specific mathematical basis as a natural method to solve the Boltzmann equation. A general operator form of this equation is used and the solution is expressed as the sum of an eigenstate of the N-process collision operator having zero eigenvalue plus a second term; the former is a drift term and the latter is diffusive. The amount of drift is determined by making the drift term orthogonal to the diffusive term; this is equivalent to a phonon momentum balance condition. As a special case, the general method may be approximated by relaxation time representation of the collision operators. The Callaway equation follows directly. (auth)

9771 (PR-P-63) PHYSICS DIVISION PROGRESS REPORT, JULY 1 TO SEPTEMBER 30, 1964. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 60p. (AECL-2108). Dep.; $1.50(AECL)

Progress is reported in each of the fields: nuclear physics, general physics, neutron physics, and theoretical physics. Among the topics treated are pulse-shape discrimination, nuclear lifetime measurement, detectors and spectrometers, space physics, nuclear models, computation, etc. (D.L.C.)

9772 (RT/FI(64)-9) EMISSIONE DI URANIO DA UO_2 PER AZIONE DEI PRODOTTI DI FISSIONE — I. (Emission of Uranium from UO_2 Caused by Fission Products — [Part] I.). G. Ambrosini, T. Bozzoni, and G. J. Segre (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Sept. 1964. 24p. Dep.(mn)

Calculations about the emission of uranium from UO_2 caused by fission fragments are carried out. (auth)

9773 (TID-21335) ANNUAL PROGRESS REPORT [ON LINEAR ACCELERATOR RESEARCH], DECEMBER 1963–JULY 1964. (Minnesota. Univ., Minneapolis. Linear Accelerator Lab.). Sept. 1964. Contract AT(11-1)-50. 171p. Dep.(mn); $5.00(cy), 3(mn) OTS.

Four sections are included; separate abstracts have been prepared for each. (T.F.H.)

For abstracts of individual sections see: 9491, 9809, 10257, and 10258.

9774 (UCRL-7784) NUMERICAL CALCULATION OF STATIC MAGNETIC FIELDS IN AN IRREGULAR TRIANGLE MESH. Alan M. Winslow (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 4, 1964. Contract W-7405-eng-48. 40p. Dep.; $2.00(OTS).

A general two-dimensional magnetostatic code has been developed, which calculates the vector potential and magnetic induction in any plane arrangement of iron, air, and conductors. It uses a mesh composed of irregular triangles in which the mesh lines can be distorted to conform to irregular interfaces and boundaries, thus eliminating the need for special equations at these places. The speed and accuracy of the calculation appear to be comparable to that obtainable using regular meshes. (auth)

9775 (UCRL-11466) PHYSICS DIVISION SEMIANNUAL REPORT, NOVEMBER 1963–APRIL 1964. (California. Univ., Berkeley. Lawrence Radiation Lab.). May 25, 1964. Contract W-7405-eng-48. 59p. Dep.; $3.00(cy), 2(mn) OTS.

Research and development is reported on bubble chambers, strange particles, heavy ions, scattering, many-body problems, weak interactions and other general physics areas. Developments in data handling, computer programs, and accelerator operations are also reported. (J.R.D.)

9776 (UCRL-12170) ON THE CALCULATION OF A COLLISION DISTANCE WHEN CONDITIONS ALONG THE PATH ARE CONTINUALLY CHANGING. J. R. Terrall (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 5, 1964. Contract W-7405-eng-48. 9p. Dep.; $1.00(OTS).

In Monte Carlo calculations for transport problems, it is necessary to know how far individual particles are likely to travel between collisions. This is a simple calculation if the collision cross sections do not change as a particle moves through a medium. However, if the cross sections are changing because of density variations or because the particles comprising the medium may themselves have velocities which cannot be ignored, the calculation may become quite involved. A simple method, and several variations on it, are suggested. (auth)

9777 (JPRS-27372) TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 121. Translation of K'o Hsueh T'ung Pao, No. 8, 706-14; 718-20; 732-41(1964). 59p. (TT-64-51628). OTS.

Nine articles are included; separate abstracts have been prepared for 3. The remaining articles are concerned with paramagnetic resonance and thermoluminescence of various organic compounds, power of ruby lasers, and instrumentational analysis. (T.F.H.)

For abstracts of individual papers see: 9171, 9898, and 10399.

9778 (SC-T-65-704) AGING DUE TO IONIZATION OF DIELECTRICS. V. Mòdoni. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Energia Elettrica, 39: 843-61(1962). 38p. Dep.(mn); $3.60(fs), $1.24(mf) JCL.

A discussion is given of the mechanism of the deterioration of dielectrics due to ionization discharges. A simple method and an apparatus are described for studying the aging. Results of the application of the method are reported, and life expectancy curves are presented for some insulating materials. (D.L.C.)

9779 AN APPLICATION OF SINGULAR INTEGRAL EQUATION THEORY TO A LINEARIZED PROBLEM IN COUETTE FLOW. A. Leonard and T. W. Mullikin (RAND Corp., Santa Monica, Calif.). Ann. Phys. (N. Y.), 30: 235-48(Nov. 1964).

A linearized problem in Couette flow, derived from a simple version of the Krook statistical model for intermolecular collisions, is treated. The problem is reduced to solving the Fredholm equations, which are shown to converge rapidly for all values of the Knudsen number. The methods are based on singular integral equations and were first developed in neutron transport theory. Cercignani, in applying Case's method to the slip flow problem, also studied similar singular equations. (auth)

9780 NATURAL CONVECTION OF AN ELECTRICALLY CONDUCTING FLUID FROM A VERTICAL PLATE IN THE PRESENCE OF A MAGNETIC FIELD. Ikuo Mabuchi. Bull. JSME (Japan Soc. Mech. Engrs), 7: 368-75 (1964).

The natural convection of an electrically conducting fluid on a vertical plate in the presence of a transverse magnetic field is analyzed for the magnetic field varying with the λth power of the vertical distance. The effect of the magnetic field on heat transfer may be uniformly described by the magnetic parameter $Z = Z_0(x/L)^{2\lambda+\frac{1}{2}}$, where $Z_0 = 2\bar{M}^2/G_{rL}^{\frac{1}{2}}$. The local heat transfer coefficient decreases as the magnetic parameter Z is increased; for example, the coefficient is 14% at Z = 1 and 45% at Z = 5 for Prandtl number $P_r \sim 0.01$ and is 11% at Z = 1 and 36% at Z = 5 for $P_r \sim 1$. Also, if the total amount or the mean value of the magnetic field intensity over $x = 0 \sim L$ is equal, the effect on the magnetic field becomes remarkable, since λ is changed from a negative to positive. (auth)

9781 APPLICATIONS OF MASS SPECTROMETERS AND ISOTOPE SEPARATORS TO NUCLEAR PHYSICS. N. R. Daly and N. J. Freeman (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Brit. Nucl. Energy Soc., 3: 320-30(Oct. 1964).

A survey was made of the application of mass spectrometers and isotope separators to problems in nuclear physics. The historical development of mass spectrometers is outlined briefly and four instruments are described. Their use in research ranging from determinations of half life to the study of reactor materials is illustrated. The contributions that were made in the atomic energy field and to the present understanding of the atomic nucleus are discussed. (auth)

9782 ENERGY LEVELS OF U^{4+} IN AN OCTAHEDRAL CRYSTALLINE FIELD. R. A. Satten, C. L. Schreiber, and E. Y. Wong (Univ. of California, Los Angeles). J. Chem. Phys., 42: 162-71(Jan. 1, 1965).

The electronic energy levels determined from absorption spectra of U^{4+} in crystals containing UCl_6^{2-} complexes were identified as to irreducible representation and the resulting set of levels used to determine the least-squares best values of Slater F_k integrals, spin-orbit ζ_{5f}, and fourth- and sixth-degree crystalline potential parameters $A\langle r^4\rangle$ and $B\langle r^6\rangle$. It was necessary to diagonalize within the $5f^2$ configuration all these interactions simultaneously. The values are $F_2 = 191.4$, $F_4 = 33.83$, $F_6 = 3.98$, $\zeta_{5f} = 1796$, $A\langle r^4\rangle = 912$, $B\langle r^6\rangle = 56.5$. New data on the spectra of the UBr_6^{2-} complex are presented. (auth)

9783 INTERNAL VIBRONICS IN TERBIUM COMPOUNDS—A COOPERATIVE PHENOMENON. S. Yatsiv, E. Ehrenfreund, and U. El-Hanany (Hebrew Univ., Jerusalem). J. Chem. Phys., 42: 743-9(Jan. 15, 1965).

Observations of absorption and emission vibronics in Tb^{3+} compounds are reported. This followed a similar analysis of Gd^{3+} compounds and a comparison was made between the two cases. A theoretical model based on a cooperative approach to these transitions was developed. This model yielded the activity of vibrational modes involved in internal vibronics. It also gave the relative intensity of a vibronic compared to its parent electronic transition as a function of the particular rare earth (RE) ion and of its physical surroundings. (auth)

9784 MECHANISM AND RATE OF THE INTRAMOLECULAR ENERGY TRANSFER PROCESS IN RARE-EARTH CHELATES. M. L. Bhaumik (Electro-Optical Systems, Inc., Pasadena, Calif.) and M. A. El-Sayed. J. Chem. Phys., 42: 787-8(Jan. 15, 1965).

Three mechanisms by which excitation energy is transfered from the ligand to the rare earth ion in rare earth chelates were studied. Results with Eu^{3+} and Tb^{3+} chelates favored the mechanisms involving the triplet state and showed that the transfer occurs in $\sim 10^{-10}$ sec. Most of the quenching seemed to occur only when the energy matching condition between the triplet level of the chelate and that of the quencher was satisfied regardless of the Eu^{3+} levels. (M.C.G.)

9785 LASER ACTION IN FLUORINATED EUROPIUM CHELATES IN ACETONITRILE. Erhard J. Schimitschek, Richard B. Nehrich, and John A. Trias (Navy Electronics Lab., San Diego, Calif.). J. Chem. Phys., 42: 788-90 (Jan. 15, 1965).

Data on laser action in europium thenoyltrifluoroacetonate (EuTTA), europium trifluoroacetylacetonate (EuTFAA), and europium benzoyltrifluoroacetonate (EuBTFA) are presented. Stable laser liquids were prepared from these chelates in acetonitrile, which operated at much higher temperatures than before. (M.C.G.)

9786 ENDOR IN IRRADIATED ADIPIC ACID CRYSTALS AT +25° AND −90°C. Alvin L. Kwiram (Stanford Univ., California) and James S. Hyde. J. Chem. Phys., 42: 791-2(Jan. 15, 1965).

Electron nuclear double resonance (ENDOR) experiments were carried out on irradiated adipic acid crystals. The single crystals were x-irradiated for several hours and heat treated at 100°C for 30 min in order to bleach signals arising from damage sites other than $(CO_2H)CH(CH_2)_3(CO_2H)$. Microwave power incident on the cavity was 1 mw and adjusted to give the largest EPR signal. The resulting room-temperature ENDOR linewidths were approximately 300 kc/sec. At −90°C the ENDOR linewidths were 120 kc/sec, but otherwise essentially identical to the spectra at room temperature. (M.C.G.)

9787 HYPERFINE INTERACTION OF THE CHLORINE NUCLEUS IN A SOLID MATRIX. N. Leray and J. Roncin (Faculte des Sciences, Orsay, France). J. Chem. Phys., 42: 800-1(Jan. 15, 1965).

Line broadening of the electron spin resonance (ESR) spectra of chlorine molecules is discussed. Radicals formed by gamma irradiation of solid $SiCl_4$ at 77°K with a dose of 16 Mrad were studied. The spectrum showed 10 lines and can be attributed to the $SiCl_3$ radical, with the equivalent chlorine nuclei. The hyperfine isotropic interaction with the ^{35}Cl nucleus, deduced from this spectrum, is 13.4 ± 0.5 G. The interaction with the ^{37}Cl nucleus, considering the difference in nuclear magnetic moments, could be estimated to be 11.1 ± 0.5 G. The agreement for the main lines between calculated and deserved spectra was very satisfactory. (M.C.G.)

9788 A METHOD FOR TREATING FLUCTUATION OF DYNAMICAL VARIABLES. Gerald L. Jones (Univ. of Notre Dame, Ind.). J. Math. Phys. (N. Y.), 6: 106-11(Jan. 1965). (COO-427-39)

An upper bound on the probability that a fluctuation of a given size will occur in a given time interval is derived. The bound is useful because it is small for cases of interest. The fluctuations of the kinetic energy in a canonical ensemble are considered as an example. (auth)

9789 MAXIMUM SPECTRAL LUMINOUS EFFICIENCY. George A. Condas (Univ. of California, Livermore). J. Opt. Soc. Am., 54: 1168(Sept. 1964). (UCRL-7868)

The maximum spectral luminous efficiency is defined, and the method for calculating it is described. A calculation is performed to obtain the presently accepted value, 679.3 lm/w. A value recommended as the most modern, (672.1 ± 4) lm/w, is calculated using the most recent and accurate values for constants involved in the computation. (M.J.T.)

9790 SPACE PROPULSION BY MAGNETIC-FIELD INTERACTION. J. F. Engelberger (Consolidated Controls Corp., Bethel, Conn.). J. Spacecraft Rockets, 1: 347-9 (May-June 1964).

It is contended that space is permeated with nonuniform magnetic fields and that a dipole of significant magnetic strength experiences accelerating forces of practical magnitude. For a space propulsion system, the dipole is created by means of a current-carrying loop of wire. The possibilities of operating the loop as a superconductor are considered. The dipole propulsive force of the earth's magnetic field is analyzed, and problems of the practical application of the interaction are discussed. (M.J.T.)

9791 AMPLIFICATION OF SOUND BY CONDUCTION ELECTRONS WITH NON-SPHERICAL ENERGY SURFACES. S. G. Eckstein (Argonne National Lab., Ill.). Phys. Letters, 13: 30-1(Nov. 1, 1964).

The amplification of sound by conduction electrons with nonspherical energy surfaces is investigated. It is shown that the threshold for sound amplification is given by the relation $\hat{q} \cdot v_d \geq \nu_s$, where $\hat{q}$ is a unit vector in the direction of propagation of sound, v_d the drift velocity, and ν_s the sound velocity. (C.E.S.)

9792 STIMULATED EMISSION IN THE FAR INFRARED FROM WATER VAPOUR AND DEUTERIUM OXIDE DISCHARGES. L. E. S. Mathias and A. Crocker (Services Electronics Research Lab., Baldock, Eng.). Phys. Letters, 13: 35-6(Nov. 1, 1964).

A pulsed electric discharge through water vapor and deuterium oxide at low pressure produced laser oscillations in the far infrared region of the spectrum. An attempt was made to obtain as complete a stimulated emission spectrum as possible in each case. The radiating molecules or radicals were not identified. (C.E.S.)

9793 HIGH-TEMPERATURE SERIES EXPANSIONS FOR THE SPIN-$\frac{1}{2}$ HEISENBERG MODEL BY THE METHOD OF IRREDUCIBLE REPRESENTATIONS OF THE SYMMETRIC GROUP. George A. Baker, Jr. (Los Alamos Scientific Lab., N. Mex.), G. S. Rushbrooke, and H. E. Gilbert. Phys. Rev., 135: A1272-7(Aug. 31, 1964). (LA-DC-6345)

It is shown how the partition functions for finite clusters with spin-$\frac{1}{2}$ Heisenberg interactions may be computed efficiently and generally to any desired number of powers in reciprocal temperature. As an example, the zero-magnetic-field free energy was expanded to the twenty-first power for the linear Heisenberg model, and for nonzero magnetic field an expression good through the tenth power is given. The concept of the two-point Padé approximant is introduced and used to analyze the energy for the linear Heisenberg model. (auth)

9794 THEORY OF GIANT QUANTUM OSCILLATIONS IN ULTRASONIC ATTENUATION IN A LONGITUDINAL MAGNETIC FIELD. John J. Quinn (RCA Labs., Princeton, N. J.). Phys. Rev., 137: A889-94(Feb. 1, 1965).

The effect of collisions on the giant quantum oscillations in the attenuation of both transverse and longitudinal acoustic waves propagating parallel to a d-c magnetic field in metals is studied. This is accomplished by using the results of Tosima, Quinn, and Lampert on the theory of collision effects on the magnetoconductivity tensor of a quantum plasma. The experimental conditions under which quantum oscillations should be observable are determined, and the information which they yield about the Fermi surface is discussed. (auth)

9795 ARC HEATERS AND MHD ACCELERATORS FOR AERODYNAMIC PURPOSES. PART I. (North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development). AGARDograph 84. Sept. 1964. 523p. (CONF-752(Pt.I))

Thirteen papers are included; separate abstracts have been prepared for 4. The remaining papers consider various aspects of shock tubes, electric arcs and arc heaters, and wind tunnels. (T.F.H.)

For abstracts of individual papers see: 10431, 10432, 10433, and 10434.

9796 MUTUAL CHARGE NEUTRALIZATION OF GASEOUS IONS. James Carl Person. Thesis, Berkeley, Calif., Univ. of California, 1964. 145p.

The problem of the bimolecular rate constant, α, for the mutual charge neutralization reaction (ion-ion recombination) for ions formed by the vacuum ultraviolet photolysis of nitric oxide is considered. The pressure dependence of α over a pressure range of 10 to 600 torr for mixtures of a few hundred microns of NO with He, Ar, Kr, Xe, H_2, D_2, and N_2 is measured. From the low-pressure limit of α, the rate constant for charge neutralization in the absence of a third body is $k_0 = 2.1 \pm 0.4 \times 10^{-7}$ cm³/sec. The high-pressure limit of α is estimated to be $2.0 \pm 0.5 \times 10^{-6}$ cm³/sec. The third-body efficiencies for promoting the charge-neutralization reaction are measured. The estimated average ionic mobilities in the gas mixtures indicate that at least some of the ions must be present as ion clusters. Also, it is shown that the addition of NO_2 or H_2O further lowers the mobility. Finally, a detailed calculation of the three-body charge-neutralization process is made using a computer. This calculation considers that the rate of charge neutralization is the rate at which ion pairs are deactivated by collision with the neutral gas molecules to form ion pairs that cannot separate to large distances. The potential between the ions and the neutrals is assumed to be an ion-induced dipole potential with a hard-sphere core. The calculation involves an average over the various angles in the collisions. The predicted values of α depend on a parameter of the calculation, but over a wide range of this parameter the predicted relative third-body efficiencies are in reasonable agreement with the experimental values. (Dissertation Abstr., 25: No. 3. Sept. 1964)

9797 COMPUTATION AND MEASUREMENT OF HALL POTENTIALS AND FLOW FIELD PERTURBATIONS IN MAGNETOGASDYNAMIC FLOW OF AN AXISYMMETRIC FREE JET. David Ridgway Otis. Thesis, Berkeley, Calif., Univ. of California, 1964. 105p.

The interaction was observed between a supersonic free jet of partially ionized argon and the magnetic field of a coil concentric with the jet. Nominal values of the parameters were: Mach number, 3; Reynolds number, 1000; magnetic Reynolds number, 0.2; magnetic interaction parameter, 1; Hall parameter, 1. The jet was strongly channelled. Axial and radial electric fields were observed in the jet with a net rise in potential across the interaction. These observations were consistent with predictions based on the single-fluid, macroscopic equations and a simple slug flow model. The current equation was solved to second order in the Hall parameter giving a closed form expression for the Hall potential that agreed with the experiments for weak fields. Flow perturbations were calculated for Mach numbers of 3.11, 6.08, and 10.05 by applying the method of characteristics to the linearized equations for a nonviscous, compressible fluid, neglecting Hall currents. The calculations are in qualitative agreement with the experiments and show Joule heating to be the major factor in perturbing the flow at high Mach numbers. (Dissertation Abstr., 25: No. 3, Sept. 1964)

9798 ELECTRONIC MAGNETIC RESONANCE AND SOLID DIELECTRICS. PROCEEDINGS OF THE XIITH COLLOQUE AMPÈRE, BORDEAUX, 17-21 SEPT. 1963. R. Servant and A. Charru, eds. Amsterdam, North-Holland Publishing Company, 1964. 583p. (CONF-630901)

Proceedings of the 12th Ampère Colloquium on Electronic Magnetic Resonance and Solid Dielectrics are presented. Separate abstracts were prepared for 13 of the 99 papers. (M.C.G.)

For abstracts of individual papers see: 9232, 9233, 9234, 9235, 9236, 9237, 9238, 9239, 9240, 9722, 10113, 10114, and 10375.

9799 APPROXIMATIONS FOR THE THERMODYNAMIC AND TRANSPORT PROPERTIES OF HIGH TEMPERATURE MHD WORKING FLUIDS. Masahiro Kishi (Shin Mitsubishi Heavy-Industries Ltd., Kobe, Japan), Masataka Mizutani, and Toshio Ito. 12p. (CONF-640701-90)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

It is noted that in the study and design of open-cycle MHD electric power generation, it becomes necessary to approximate the thermodynamic and transport properties of high-temperature working fluids. To approximate these properties, dissociation reactions at 2000 to 3400°K must be considered, and therefore these properties fall between the two extreme states, frozen and equilibrium. The method of approximation and results of calculation of these properties in the C, H, O, N, K system at the two states are presented assuming that the existing gas components in the system are H, N, O, K, H, OH, NO, CO, and HO and that they obey the ideal gas law. The properties of approximations applied are gas composition, thermodynamic properties, and transport properties. (J.R.D.)

9800 EXPERIMENTAL INVESTIGATION OF NON-EQUILIBRIUM IONIZATION IN A MIXTURE OF ARGON AND POTASSIUM. A. E. Sheindlin, V. A. Batenin, and E. I. Asinovsky (Inst. of High Temperatures, Moscow). 13p. (CONF-640701-102)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Results of a study concerning nonequilibrium ionization in weak-current arc burning in Ar–K mixtures at about 1 atm. are presented. Results show that essential deviations from the thermodynamic equilibrium may occur under these conditions. Such deviation from equilibrium occurs at comparatively small values of electric field intensity. This method appears attractive for building up non-equilibrium conductivity in MHD generator research. (J.R.D.)

9801 EFFECTS GOVERNING MAGNETICALLY INDUCED IONIZATION. B. Zauderer (General Electric Co., King of Prussia, Penna.). 12p. (CONF-640701-101)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Magnetically induced ionization was studied in which xenon was shock heated to 5000 to 8000°K producing an initial electric conductivity of 100 mhos/m. In this conductivity range, the electric conductivity is a function of electron density and can be used to detect magnetically induced ionization. The MHD generator used in the experiments had an individually short-circuited segmented electrode geometry and was mounted near the downstream end of a shock tube. (J.R.D.)

9802 NATURE OF A HIGH CURRENT DISCHARGE IN AN ARGON–POTASSIUM ATMOSPHERE AT ELEVATED TEMPERATURES. M. Sakuntala (United Kingdom Atomic Energy Research Establishment, Harwell, Berks, Eng.). 13p. (CONF-640701-69)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

An experiment is described consisting of an arrangement in which the discharge that may develop in a MHD generator is investigated in the absence of a magnetic field. The nature of the discharge that exists at higher currents is discussed. It is produced by applying an external voltage to the electrodes immersed in plasma rather than inducing electromotive forces in the manner used in MHD devices. (J.R.D.)

9803 RECOMBINATION AND ELECTRODE EFFECTS IN EXTRA-THERMALLY IONIZED ARGON. P. B. Curtis and A. Reddish (Hirst Research Centre, Wembley, Middx., Eng.). 11p. (CONF-640701-70)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Electric conductivity effects in extra-thermally ionized Ar near room temperature and pressure in the absence of magnetic fields were examined. The experiments yielded information on conduction characteristics at low current densities, for sets of coaxial cylindrical electrodes immersed in Ar ionized by r-f discharge. A cold cathode of W wire was used throughout the work. (J.R.D.)

9804 CONDUCTION PROCESSES IN RECTANGULAR DUCTS WITH CONTROLLED ELECTRIC FIELDS. J. F. Armstrong, B. J. Elliott, D. W. George, H. K. Messerle, and A. D. Stokes (Univ. of Sydney). 9p. (CONF-640701-64)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Experiments were conducted with rectangular magnetohydrodynamic (MHD) ducts aimed at controlling and simplifying conditions so that closer correlations of experimental and theoretical performance are possible. The major parameters requiring closer control are gas purity and homogeneity. Results show that rectangular ducts fed with arc-heated inert gases may be subject to important gas inhomogeneities. Spectroscopic analysis using small angular beams appears to be the best tool for detecting inhomogeneities. (J.R.D.)

Accelerators

9805 (BNL-8761) AN RF BEAM SEPARATOR WITH MILLISECOND PULSE LENGTH. H. Hahn and H. J. Halama (Brookhaven National Lab., Upton, N. Y.). Jan. 4, 1965. Contract AT-30-2-GEN-16. 6p. Dep.(mn); $1.00 (cy), 1(mn) OTS.

It is concluded that an r-f beam separator with millisecond pulse length is feasible for particles in the range from 5 to 10 Bev/c. The 2-msec pulse length is, of course, far from ideal. It should be kept in mind that the effective operational time equals pulse length times separation factor. The latter is hoped to be somewhere between 1000 and 10,000. It is therefore fair to say that the proposed r-f separator corresponds to an unseparated beam with 2 to 20 sec flat-top. On the other hand, two systems have also to be compared on the basis of the system's acceptance (or transmission), which may well be defined as the product of solid angle times fractional momentum bite times the fraction of particles not undergoing decay in flight. (auth)

9806 (NP-14418) RAZRABOTKA V MIFI SERIINYKH LINEINYKH USKORITELEI ELEKTRONOV. (Development of Serial Linear Electron Accelerators at the Moscow Inst. of Engineering Physics). O. A. Val'dner (U.S.S.R.). [1960]. 13p. Dep.(mn).

Descriptions are given for two linear electron accelerators operating at 3 and 5 Mev, respectively. (R.V.J.)

9807 (TID-4100(Suppl.25)) SUPPLEMENTAL INSERT SHEETS FOR ENGINEERING MATERIALS LIST. Supplement 25. Richard E. C. Duthie, ed. (Division of Technical Information Extension, AEC). Dec. 1964. 65p. Dep.; Free (DTI Extension)

Engineering materials lists are presented for the 88-inch cyclotron (CAPE-1030). (D.L.C.)

9808 (TID-21282) A FINAL REPORT ON THE DESIGN OF A VERY HIGH-INTENSITY PROTON LINEAR ACCELERATOR AS A MESON FACTORY AT AN ENERGY OF 750 Mev. (Yale Univ., New Haven). Oct. 1964. Contract AT(30-1)-2726. 506p. (Y-12) Dep.(mn; $8.06(cy), 11(mn) OTS.

The design of a very-high-intensity proton linear accelerator and its associated facilities, which together form a complete meson factory, is described. The accelerator will deliver a 1 mA (average) primary proton beam at an energy that is variable from 190 to 753 Mev. Polarized protons can also be accelerated. The intense primary proton beam, which can be fully extracted from the accelerator, will produce intense well-defined secondary beams of pions, muons, neutrons, and neutrinos. These secondary beams will be separated from the proton beam and transported to various experimental areas where adequate shielding, both flexible and fixed, is provided. The scientific justification and experimental program, the accelerator, the experimental areas and the building complex, and cost and manpower estimates for the installation are discussed. (auth)

9809 (TID-21335(p.1-32)) ACCELERATOR PROGRESS. (Minnesota. Univ., Minneapolis. Linear Accelerator Lab.).

A review is given of: linac operations; operations of a polarized proton source; instrumentation improvements; and d-c injector design at the Univ. of Minnesota. (T.F.H.)

9810 7-Gev PROTON SYNCHROTRON NOW FULLY OPERATIONAL. Elec. Export Rev., 3: 73(July-Sept. 1964).

A description is given of Nimrod, the 7-Bev proton synchrotron which was recently inaugurated at the opening of the Rutherford Laboratory of the National Institute of Research into Nuclear Science in England. Protons are produced from ionized hydrogen and introduced into the vacuum chamber of the main machine where they are accelerated in a circular orbit, with an energy gain of 7 kev per revolution. The total acceleration time is 0.7 sec, during which the proton pulse makes one million orbits of the 155-ft dia main magnet ring. Up to 10,000 a at 15 kv is needed to energize the magnet during this short period. The energy is obtained from two 12.8-kv generators driven by two 5100-hp induction motors. The four machines and two 30-ton flywheels are mounted on a common shaft, the whole set weighing 400 tons. The dc magnet supply is obtained from water-cooled excitron rectifiers fed from four transformers. While the magnet current decays to zero, the convertors function as invertors and the energy stored in the magnet is returned to the supply system. Protons are extracted from the vacuum chamber as a beam, using bending magnets similar to those used for injection, or they are allowed to bombard targets inside the magnet ring, the resulting secondary particles being channeled into the experimental areas. The protons are injected with a velocity of 17% of the speed of light. The frequency of the alternating electric field and the flux density of the magnetic field must be increased to stay in synchronism with the rate of rotation of the proton pulse and to keep the orbital radius constant. The frequency is increased from 358 kc/sec to 2.01 Mc/sec and the magnetic field increased from 300 G to 14,000 G from injection to obtaining full energy. The particles leave the machine at a velocity of 99.6% the velocity of light. (BBB)

9811 INVESTIGATION OF STATISTICAL PHENOMENA OF PARTICLE MOTION IN CYCLIC ACCELERATORS BY MEANS OF KINETIC EQUATIONS. V. D. Il'in (Moscow State Univ.). Izv. Vysshikh. Uchebn. Zavedenii, Fiz., No. 5, 96-8(1964). (In Russian)

Statistical problems of charged particle motion in accelerators were studied using kinetic equations of a single-charge distribution function for linear oscillation amplitudes. (tr-auth)

9812 DEVELOPMENT OF WAVEGUIDE CYCLIC ACCELERATORS. A. A. Vorob'ev and A. N. Didenko (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh. Uchebn. Zavedenii, Fiz., No. 5, 111-14(1964). (In Russian)

The advantages of waveguide accelerating system were compared with the ordinary high-energy resonator systems. It is shown that the electric spark treatment carried out in the experiment was capable of producing a high precision accelerator system for a waveguide cyclic accelerator. Investigations of the experimental chamber for the waveguide cyclic accelerator indicated that the field structure was not distorted even with low precision systems. (R.V.J.)

9813 THE ESTIMATION OF THERMAL VELOCITY EFFECTS IN THICK STEADY BEAMS. P. T. Kirstein (General Electric Co. Research Lab., Zurich). J. Electron. Control (1), 17: 521-8(Nov. 1964).

Previous analyses for estimating thermal velocity effects in paraxial, axially symmetric beams are extended to cover thick beams. By using a perturbation of the zero-temperature behavior, a 6 × 6 matrix is set up relating the exit parameters of the beam with the entrance ones. By suitable assumptions at the cathode, e.g. assuming a half-Maxwellian current distribution, expressions are derived for the current density emerging from the system. It is shown that, in the limiting case of a paraxial solid beam, the expressions simplify to ones developed earlier. (auth)

9814 ISOCHRONOUS CYCLOTRON. K. Kult. Jaderna Energie, 10: 264-6(1964). (In Czech.).

The characteristics of several cyclotrons capable of reaching relativistic energies are summarized. Graphs and tables are presented of some parameters, including the ranges of beam current, power requirements, and energy attainable for the FFAG cyclotron, the AVF cyclotron, the phasotron, and the proton synchrocyclotron. The cyclotrons are compared with other accelerators as regards energy dispersion. Graphs are given showing the relations of energy, frequency, and magnetic field strength for various ions in the AVF cyclotron ORIC. A short discussion is presented of the characteristics of the mc^2 cyclotron proposed to be built at Oak Ridge. (TTT)

9815 CHARACTERISTICS OF ACCELERATOR SIGNAL ELECTRODES AS A FUNCTION OF THEIR TRANSVERSE CROSS SECTION AND CONSTRUCTION. I. P. Karabekov and M. A. Martirosyan (Inst. of Physics, State Commission on Peaceful Application of Atomic Energy, USSR). Pribory i Tekhn. Eksperim., No. 5, 36-40(Sept.-Oct. 1964). (In Russian)

Effects of signal electrode shape and construction on the characteristics and sensitivity of signal transformation were studied. The obtained data were used for calculations on electrodes of arbitrary shape. (tr-auth)

9816 A DEVICE FOR VARYING γ-PULSE DURATION IN A BETATRON γ EMISSION. N. N. Balamatov, A. V. Balashov, and B. A. Yur'ev (Moscow State Univ.). Pribory i Tekhn. Eksperim., No. 5, 41-3(Sept.-Oct. 1964). (In Russian)

A method was developed for extending the γ-pulse duration in a betatron. Descriptions are given of the scheme for developing current pulses used for transporting electrons to the target. The scheme was capable of extending the γ pulse duration in a 35-Mev betatron from 100 to 180 μsec. Electron energy stability during extended γ-pulse duration was estimated. (tr-auth)

9817 COSMOTRON POLE FACE WINDINGS GENERATOR SYSTEM PERMITTING LONG BEAM SPILL. J. G. Cottingham and J.-L. Pellegrin (Brookhaven National Lab., Upton, N. Y.). Rev. Sci. Instr., 36: 165-6(Feb. 1965).

A scheme is described for maintaining a constant current in the magnetic field correction windings of the Cosmotron, during the process of beam ejection and long spill-out. A solid state switch is used to apply compensation for the vanishing induced voltage in these correction windings. It is shown how this method could be applied in the event beam ejection and long spill-out would be performed at two different energies. (auth)

9818 "FLOATING WIRE" TECHNIQUE FOR TESTING MAGNETIC LENSES. Uriel Vogel (Univ. of Michigan, Ann Arbor). Rev. Sci. Instr., 36: 188-92(Feb. 1965).

Improvements in the well-known technique of using a current-carrying wire to simulate particle trajectories in a magnetic field are described. As presently used, the parameters of magnetic lenses can be determined for a resolution in momentum as large as 10^4. (auth)

9819 USE OF MOLECULAR BEAMS FOR NEUTRAL BEAM INJECTORS. A. B. Wittkower, P. H. Rose, R. P. Bastide, and N. B. Brooks (High Voltage Engineering Corp., Burlington, Mass.). Rev. Sci. Instr., 36: 240-1(Feb. 1965).

The use of molecular beams rather than atomic beams for neutral beam injectors is discussed. The initial advantage of using the molecular components rather than the atomic components for neutral beam production is that it is usually considerably easier to produce large numbers of neutral atoms. (C.E.S.)

9820 THE RADIO FREQUENCY SYSTEM OF THE I.P.C.R. 1.6m CYCLOTRON. I. CAVITY RESONATOR. Yoshiaki Chiba, Masatoshi Odera, and Takashi Fujisawa. Rika Gaku Kenkyusho Hokoku, 40: 67-74(1964). (In Japanese)

The variable energy cyclotron is designed to accelerate protons, deuterons, alpha particles, and other multiple charged atoms through carbon and nitrogen. This wide application is made possible by a high output frequency generator which is capable of varying frequency over the range of 6-14 Mc. Protons are accelerated to slightly below 3 Mev at 6 Mc, 12.5 Mev at 11.2 Mc, and 20 Mev at 14.1 Mc. Deuterons are accelerated to 25 Mev and alpha particles to 50 Mev at 11.2 Mc. Voltage to a maximum of 260 kV is applied to the accelerating poles, and the Q value of the resonant system which includes the accelerating poles is kept at a fairly high level. Resonant frequency is varied by actuating a short plate which alters inductance, thereby altering capacitance of accelerating poles to raise or lower frequency to desired level and bring about a resonant system with favorable Q value. This short plate is the same device used at the Institute of Nuclear Research, Tokyo University. The functions of this plate in both in phase and out of phase operations are described. (TTT)

9821 APPLICATIONS OF INCOHERENT ELECTRON RADIATION FROM A SYNCHROTRON. Yu. M. Ado. Tr. Fiz. Inst., Akad. Nauk SSSR, 19: 66-97(1963). (In Russian)

Theories of coherent and incoherent synchrotron radiation in the visible range are reviewed. Apparatus is described for measuring incoherent visible radiation from a 280-Mev synchrotron. The relative spectra of incoherent radiation of 4000 to 6100 Å from 150 to 250 Mev electrons are measured and compared with theory. The light is measured with a photomultiplier shielded from bremsstrahlung; the bremsstrahlung intensity is used as a measure of the electron flux. The intensity decreases as the radiation wavelength increases; the rate of decrease is greatest for 250 Mev electrons. The incoherent radiation may be used to measure operating parameters of the synchrotron. The number of electrons in one synchrotron pulse is determined by comparing the response of the photomultiplier to a synchrotron pulse with its response to the light from a calibrated tungsten filament. The fraction of stray electrons striking the target before full acceleration is determined by comparing experimental and theoretical values of the electron-energy variation of the intensity of the visible incoherent radiation. The fraction of stray electrons ranges from 70% for electron energy E = 270 Mev to 10% for E = 200 Mev with dee voltage V = 850 volts; for V = 1600 volts and all E there are no stray electrons. The width of the light pulse is measured by polarizing the incoherent radiation and is the same as the width of the electrons in the synchrotron pulse. (TTT)

9822 THE 30-Mev SYNCHROTRON AT THE PHYSICAL INSTITUTE (OF THE ACADEMY OF SCIENCES, USSR). Tr. Fiz. Inst., Akad. Nauk SSSR, 19: 98-150(1963). (In Russian)

The construction of the synchrotron and its initial operation in 1948 are described in detail. The operating frequency is 228 × 10⁶ cps; the pulse repetition rate is 150 cps; the amplitude of the magnetic field is 4200 oersteds; the radius of the electron beam is 21.0 cm. Electrons are accelerated to 4.6 Mev with the machine operating in the betatron regime. The angular divergence of the bremsstrahlung photon beam is 11° for 4.6 Mev electrons and 4.5° for 27 Mev electrons. The acceleration tube was made from molybdenum glass coated on the inside with silver having a resistance of 20 ohms. The operating vacuum is 2×10^{-6} mm Hg. The acceleration time is 1.6 msec; the pulse width is 15 μsec. The high-frequency generator and the control system are also described. (TTT)

9823 DEPENDENCE OF THE INTENSITY OF γ-RADIATION FROM A BETATRON ON THE BASIC PARAMETERS OF INTERNAL ELECTRON INJECTION. V. N. Logunov and S. S. Semenov. Tr. Fiz. Inst., Akad. Nauk SSSR, 19: 151-7(1963). (In Russian)

The effectiveness of injecting electrons at the inner boundary of the stable orbit was studied. Two similar 12-kv injectors were constructed and placed at points equidistant from the inner and outer boundaries of the stable orbit at the centerplane of a 30-Mev betatron. The injectors were driven by generators giving a triangular or trapezoidal pulse. The absolute γ intensity was the same for both injectors. The γ-intensity rises rapidly to a maximum as the injector emission current i_{em} is increased, and then drops off. For i_{em} = 50 μamp most of the accelerated electrons come from the front of the injection pulse. For i_{em} = 300 μamp the decaying side of the pulse supplies most of the electrons. For i_{em} = 150 μamp the contributions of both sides are about the same. Space charge effects were also studied. The experimental results are compared with previously published theories. (TTT)

9824 THE PROBLEM OF RADIATION DAMPING OF BETATRONIC OSCILLATIONS. A. A. Sokolov, I. M. Ternov, and Yu. M. Loskutov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 101-3(May-June 1964). (In Russian)

An attempt was made to obtain not only fluctuation activation of betatronic oscillations, but also classical damping using a nonrelativistic approximation in addition to the quantum method. It is shown that one cannot obtain radiation damping in either the classical case or the quantum case because quadratic terms in r and (dr/dt) are neglected in the equations of motion, i.e. "parabolization" of the potential energy describing the betatronic oscillations is carried out. It was pointed out that "parabolization" of the potential energy actually takes place in both the classical and quantum calculations. With the help of the classical theory an expression was found for radiation damping: $\ddot{x} + \gamma\dot{x} + \omega_r^2 x = -(q/1 - q)\,(\overline{W}^{\kappa\pi}/E)\,\dot{x}$. It was shown that the criticism of Kheyfets and Orlov concerning the origin of classical damping cannot be applied to the ultrarelativistic case of "free" betatronic oscillations. (R.V.J.)

9825 METHOD FOR CHOOSING THE CONFIGURATION OF THE SPIRAL RIDGE IN AN ISOCHRONOUS CYCLOTRON. Shou-shen Fang. Wu Li Hsueh Pao, 18: 311-20(1962).

The isochronous cyclotron with the formula of the magnetic field variation $f = \epsilon \sin[\Phi(r) - N\varphi]$ was studied. The method for selecting the curves shape $\Phi(r)$ is discussed, hence the most suitable shape satisfying some definite conditions, was found. In the center of the cyclotron the structure should be taken as Thomas formula, while in the area with greater radius, some Archimedes spirals, possessing different parameters, conjoined sectionally in smooth curves can be used. By application of such configurations many advantages can be obtained, such as decreasing the defocusing force in the center of the cyclotron to the minimum, and weakening the non-linear resonant effect. Besides, for the sake of overcoming the defocusing force in the central region at the same phase-shift conditions where the required Dee voltage for acceleration will also decrease considerably, it also results in getting the maximum magnetic gap. (Sci. Abstr. China, Math. Phys. Sci., No. 3, 1963).

9826 A PROTON ELECTROSTATIC ACCELERATOR. Ming-han Yen, Liang-feng Sun, Chien-ming Shyu, et al. Wu Li Hsueh Pao, 19: 60-9(1963).

A proton electrostatic accelerator of the high pressure type is described. The inner diameter of the high pressure tank of the accelerator is 1.4 meters. The accelerating tube is made of pyrex glass rings and disk type aluminum electrodes. The total length of the accelerating tube is about 2.5 meters. The proton beam is analyzed with an electrostatic analyzer. The voltage of the accelerator is stabilized by means of corona triode. The protons accelerated by this accelerator have a maximum energy of 2.3 Mev, with 2.5 Mev momentary. The accelerator has been in operation for more than four years. (Sci. Abstr. China, Math. Phys. Sci., No. 4, 1963)

9827 RABOTA S PUCHKOM TORMOZNOGO IZLUCHENIYA. (OSOBENNOSTI METODIKI FIZICHESKIKH ISSLEDOVANII NA ELEKTRONNYKH USKORITELYAKH). (Operations Using Bremstrahlung Beams. (Singularities of Physical Methods of Investigation Using Electron Accelerators)). O. V. Bogdankevich and F. A. Nikolaev. Moscow, Atomizdat, 1964. 248p.

The problems encountered in handling and operating a bremsstrahlung beam are discussed. Radiation spectron, methods for studying absolute and relative bremsstrahlung beam intensity, measurements and stabilization of accelerated electron energy in a cyclic electron accelerator (of betatron and synchrotron type) are analyzed as well as the methods for measuring activation curves and calculating photonuclear reactions. Accelerator control instrumentations are also discussed. Tables of calculated bremsstrahlung spectra are included. (R.V.J.)

9828 PROBLEMS OF AUTOMATION AND STABILIZATION OF A LINEAR ELECTRON ACCELERATOR. E. V. Armenskii and O. A. Valdner. p.40-7 of "Elektronika Uskoriteli." Moscow, Gos. Izv. Vysshaya Shkola, 1964.

Methods are examined for increasing the stability of accelerator parameters by invention of stabilizing and automatic devices and for automation of the accelerator during start-up and operation. The basic requirements for a system of stabilization and automatic regulation of linear electron accelerator operation are described. It is shown that use of such systems makes it possible to significantly lower the requirements on the input parameters of the power supply, leading to a reduction of the outlay during manufacture of linear electron accelerators for small and medium energies. For high-energy accelerators such as cybernetic control system will make it possible to review the allowances for design, manufacture, and adjustment, using a system of self-adjustment in the process of exploitation, also producing a reduction of cost. (auth)

9829 USE OF TITANIUM PUMPS FOR EVACUATION OF BETATRON CHAMBERS. A. G. Vlasov and V. P. Ponomarev. p.386-91 of "Elektronika Uskoriteli." Moscow, Gos. Izv. Vysshaya Shkola, 1964.

The generally accepted method of obtaining a high vacuum in accelerating chamber of a betatron by means of an uninterrupted evacuation by an oil-vapor diffusion pump does not fulfill the necessary requirements and has a number of deficiencies. A small pump was developed in which sputtering of Ti occurs during heating by means of electron bombardment. The cathode of 0.5 mm W wire in the form of an Archimedian spiral is placed between the Ti collectors, to which is applied an alternating (with respect to the cathode) voltage of 1200 v. Using this pump for evacuation of the ceramic chamber of 25 Mev betatron, a maximum vacuum of 8×10^{-7} mm of Hg was obtained. Diagrams of the Ti pump, including its semi-sealed off chamber, and the arrangement for measuring the speed of gas separation and inleakage of the chamber are shown. The bibliography contains nine items. (auth)

9830 CONSTANT PHASE VELOCITY ACCELERATION SECTIONS IN A PROTON LINAC. A. Parain. 8p. (CONF-650-10)

From Linear Accelerator Conference, Stoughton, Wis., July 1964.

A reference particle is defined for an accelerator such that the motion of all other particles may be related to it. Analysis of particle motion reveals that it is possible to use constant phase velocity acceleration sections in a linac if the number of synchrotron oscillations per section is less than 0.3. With this condition, it is possible to obtain a large enough area of stability and an efficiency of 0.9 for a proton linac of energy between 200 Mev and 3 Bev. (H.D.R.)

9831 ZGS INJECTOR OBSERVATIONS. Philip V. Livdahl. 17p. (CONF-650-11)

From Linear Accelerator Conference, Stoughton, Wis., July 1964.

The effects of beam loading on the cavity gradient as the beam currents become increasingly large are examined for the 50-Mev linear injector of the Zero Gradient Synchrotron. The observations show that very precise r-f level control is necessary to meet the design requirements of a multicavity system to maintain the required injection energy as the beam progresses from section to section. By appropriate programming of the r-f level of the ZGS injector, it may be possible to use the changing energy characteristic to an advantage by providing an increasing injection energy with pulse length. (H.D.R.)

9832 A POSSIBLE APPROACH TO THE INITIAL ADJUSTMENT OF A LONG LINAC. G. W. Wheeler and T. W. Ludlam (Yale Univ., New Haven). 6p. (CONF-650-8)

From Linear Accelerator Conference, Stoughton, Wis., July 1964.

A method is presented for initial adjustment of multicavity linacs suitable as injectors for large synchrotrons. The first stage of the adjustment would assure the acceleration of the entire captured beam without the loss of particles at high energies by precise control of the field level and intercavity phase. The second stage involves reducing the beam energy spread and emittance to the smallest values that can be achieved. (H.D.R.)

Astrophysics and Cosmology

9833 MEASUREMENT OF SOLAR X RAYS BY MEANS OF SATELLITES. G. Righini. Ann. Geofis. (Rome), 17: 155-6(1964). (In Italian)

It is pointed out that the x rays from the sun originate in the corona where the temperature of the plasma is in the order of 10^6 to 10^7°K. At such temperatures, the thermal energy of the electrons ranges from 100 to 1000 ev, and when this energy is absorbed in the plasma, weak x rays, in the wavelength range of 10 to 100 Å, are emitted. An early discovery in this field made by the U. S. Naval Research Laboratory (NRL) of Washington which consists of placing small ionization chambers in the head of Aerobee rockets, shot over White Sands, New Mixico, is cited. The resulting measurements showed that the intensity of this radiation is extremely variable, and can be several times greater than normal during solar events. A method was developed in which it was possible to obtain time records that, when synchronized with the signals provided by the satellite, made possible the correlation of the different tapes. The curves obtained permitted calculation of the number of ergs emitted per cm² per section in a determined wavelength interval. This project was conducted to relate the occasional variations of intensity to the phenomena observed in the chromosphere with Lyot's filter and spectroheliograph. (T.C.O.)

9834 SOURCE-FUNCTION EQUALITY IN MULTIPLETS. R. Grant Athay (Univ. of Utah, Salt Lake City). Astrophys. J., 140: 179-85(Nov. 15, 1964).

Necessary and sufficient conditions are derived for equality of source functions for different lines within multiplets at a given location in a stellar atmosphere. The approach involves an algebraic treatment of the statistical equilibrium equations together with a parametric representation of the solutions to the coupled transfer equations. Waddell's criterion for source-function equality within multiplets is shown to be sufficient but not necessary. (auth)

9835 THE TEMPERATURE STRUCTURE OF EARLY-TYPE MODEL STELLAR ATMOSPHERES. I. DETAILED ANALYSIS OF A 10,000°K MODEL. S. E. Strom and E. H. Avrett (Smithsonian Astrophysical Observatory, Cambridge, Mass. and Harvard Coll. Observatory, Cambridge, Mass.). Astrophysics, J., 140: 1381-90(Nov. 15, 1964).

Calculations are presented for five model atmospheres, all with $T_{eff} = 10,000$°K and $\log g = 4$, which illustrate the detailed effects of individual opacity sources, scattering processes, the Lyman continuum, and the blended wings of the higher Balmer and Lyman lines. (auth)

9836 CIRCUMSTELLAR ENVELOPES FORMED THROUGH ROTATIONALLY FORCED EJECTION. D. Nelson Limber (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 140: 1391-1400(Nov. 15, 1964).

The problem considered is that of determining the density distribution in circumstellar envelopes formed through rotationally forced ejection. For an idealized formulation in which viscous and magnetic forces are neglected, in which there is axial symmetry, and in which the only motions are circular motions in planes perpendicular to the star's rotation axis and centered on this axis, the forms of the surfaces of constant density are derived assuming that the surfaces of constant pressure and density are identical. The density calibration of these surfaces is derived for several important cases. (auth)

9837 MASS LOSS FROM T TAURI STARS. L. V. Kuhi (Lick Observatory, Mt. Hamilton, Calif.). Astrophys. J., 140: 1409-33(Nov. 15, 1964).

The broad emission lines of H and Ca II in the spectra of T Tauri stars are interpreted in terms of a simplified model for the assumed mass-loss phenomenon. The expanding envelope is taken to be spherically symmetric, with the ejected atoms all having the same initial velocity and subjected only to gravitational forces. The emitting volume, essentially an H II region, is surrounded by an absorbing shell moving radially outward that produces the violet-displaced absorption components. A fit of computed line profiles to observed contours gives the particle density at the surface of the star. This value combined with estimates of the stellar temperature and radius gives the present rate of mass loss. For six representative stars with varying emission-line strengths these rates range from 0.3 to 5.8×10^{-7} $m_\odot$ year^{-1}, with an average of 3.7×10^{-8} $m_\odot$ year^{-1}. No definite mechanism is proposed for the mass ejection, although it seems reasonable that a flux of high-energy protons postulated to account for the large extent of the ionized envelope may also be indirectly responsible for the ejection. From the statistics of T Tauri stars, it is estimated that at any one time approximately

40 per cent of the contracting stars may be losing mass. A preliminary analysis of the effect of mass ejection on the time scale of the contraction, making use of Iben's theoretical tracks, indicates that mass ejection may be of some significance. Although it produces only about a 10 per cent decrease in the contraction time, the energy involved may at times be comparable to the radiated luminosity. Furthermore, a 1.0-m⊙ star may altogether lose as much as 0.4 m⊙, a non-negligible amount. It would seem that the effect of mass ejection should be considered in future computations of evolutionary tracks. (auth)

9838 THE VELOCITY FIELD IN M51. E. Margaret Burbidge and G. R. Burbidge (Univ. of California, San Diego, La Jolla). Astrophys. J., 140: 1445-61(Nov. 15, 1964).

The prime-focus spectrograph on the Lick 120-inch telescope and the Babcock spectrograph at the prime focus of the McDonald 82-inch telescope were used to make a detailed study of the motions of the ionized gas in M51. Observations of a number of emission patches in the spiral arms were made to determine the form of the rotation curve, and it was concluded that the position angle of the line of nodes is 0° with an uncertainty of about 10°. From the rotation curve it was determined that the mass of M51 within 5.5 kpsc of the center is $\lesssim 6 \times 10^{10}$ M⊙, where a distance of 4 Mpsc was taken. A large number of spectra were obtained through the nuclear region (in general within about 30″ or 600 psc from the center) in fifteen position angles. By projecting the rotation curve into the various position angles and comparing the curves with the observed velocities, large scale departures from circular motion were found. These have magnitudes $\lesssim$100 km/sec in the line of sight and are of both signs. The velocity field is highly asymmetrical with maximum departures from circular motion between 51.5 and 81.5° in both the NE and SW quadrants. Departures are also seen in position angles 24 and 141.5°. A discussion is given of the various types of noncircular motions which are compatible with the observations, or can be ruled out by them. Finally, a spectrum of NGC 5195 is described. It is concluded that this galaxy is a dwarf S0 system and not an irregular galaxy similar to NGC 3077 and M82 as was previously proposed. (auth)

9839 TRANSPORT OF MAGNETIC FIELDS ON THE SUN. Robert B. Leighton (California Inst. of Tech., Pasadena). Astrophys. J., 140: 1547-62(Nov. 15, 1964).

The dispersal and migration of unipolar and bipolar magnetic regions on the sun are quantitatively interpreted as a random-walk, diffusion-like process caused by supergranulation convection currents in the sun's outer layers. The time-dependent strength and sign of the polar fields are deduced approximately from the positions, fluxes, and axial tilts of the individual spot groups associated with the sunspot cycle. The well-known predominance of the preceding spot of a group is attributed to a characteristic field configuration which renders p spots relatively stable against fragmentation by the supergranulation currents. The relation of the random-walk process to the solar cycle is briefly discussed, and the 11-year period is interpreted as the summation of five more-or-less distinct parts. (auth)

9840 SOLAR FLARES CAUSED BY THE SKIN EFFECT IN TWISTED MAGNETIC FIELDS. Donat G. Wentzel (Univ. of Michigan, Ann Arbor). Astrophys. J., 140: 1563-78(Nov. 15, 1964).

An optical flare may be caused by the collapse of an unstable chromospheric region, under the action of magnetic forces, toward a surface of minimum but finite magnetic field strength. The compression of the magnetic field during the collapse results in forces which stop the collapse, in a time comparable to the rise time of flare light curves. Turbulence is likely to occur if the velocities of collapse can become comparable to Alfvén speeds. The turbulence provides sufficient ohmic dissipation of the magnetic fields to explain the rate of optical emission. The emission is localized in thin surfaces at the eddy boundaries. The total depth of the emitting surfaces crossed by a line of sight is in agreement with inferences from observations. If the same kind of collapse which causes an optical flare in the chromosphere occurs at greater heights, the density is insufficient to radiate away the thermal energy derived from ohmic dissipation. The result is heating, with attendant radio, x-ray, and particle events, instead of an optical flare. The conditions under which turbulence may occur are investigated. Some of the consequences of the theory relate to flare light curves, homologous flares, and rates of expansion of flare areas. (auth)

9841 REPLY TO ATHAY'S PAPER: "SOURCE-FUNCTION EQUALITY IN MULTIPLETS." John Waddell, III (Kitt Peak National Observatory). Astrophys. J., 140: 1586-9(Nov. 15, 1964).

The criticisms made by Athay (1964) of the necessary and sufficient condition for source-function equality, $C_{32} \gg A_{31}$, are examined in detail. The necessary condition Athay derives for source-function equality, $C_{32} \gg (\rho_{31} + \rho_{21})A_{31}$, arises through the parametric representation of the equations of transfer, which is to replace $A_{31} = \rho_{31}A_{31}$ and $A_{21} = \rho_{21}A_{21}$. Athay's and the present criteria are, in fact, identical by definition. The difference arises through an interpretation by Athay that the gross radiative de-excitation rate equals the net radiative de-excitation rate. (auth)

9842 STELLAR WINDS AND AGES OF OLD CLUSTERS. Donald D. Clayton (Rice Univ., Houston, Tex.). Astrophys. J., 140: 1604-6(Nov. 15, 1964).

It is pointed out that derived ages of our galaxy are also upper limits with respect to the effects of stellar winds. A simple perturbation calculation is presented to quantitatively isolate the effect of these winds. Results are given of an analysis of constant stellar winds from 10^{-13} to 10^{-10} M⊙/yr, determining the range of winds for which the age shift is significant. (M.J.T.)

9843 THE SURFACE RATIO OF N^{14} TO C^{12} DURING HELIUM BURNING. Icko Iben, Jr. (California Inst. of Tech., Pasadena). Astrophys. J., 140: 1631-3(Nov. 15, 1964).

It is pointed out that the ratio of ^{14}N to ^{12}C at the surface of a star undergoes a significant increase during the rise into the red-giant region immediately preceding the phase of He burning in the core. Evolutionary calculations were carried out, showing that a population I star in the mass range $3 \leq M/M_\odot \leq 9$ spends about 25% of its life in the core He-burning stage. Paths in the HR diagram are shown for a variety of stellar masses of population-I initial composition, and the evolutionary lifetimes required for each model star to reach labeled points are given. (M.J.T.)

9844 COSMIC X- AND INFRARED RAYS AS TOOLS FOR EXPLORING THE LARGE-SCALE STRUCTURE OF THE UNIVERSE. R. J. Gould and D. W. Sciama (Univ. of California, San Diego and Cambridge Univ., Eng.). Astrophys. J., 140: 1634-5(Nov. 15, 1964).

Significant cosmological information can possibly be obtained from observations of the cosmic background at x-ray and infrared wavelengths. Possible conclusions on the density and temperature of the intergalactic gas and the density of intergalactic H I are discussed. A test for the steady-state and Einstein-de Sitter models of the universe is proposed, using hypothetically observed characteristic x-ray lines superimposed upon the continuum. (M.J.T.)

9845 ON THE DEFINITION OF THE EFFECTIVE H_α-LINE WIDTH. L. Fritzová-Švestková (Astronomical Inst., Czechoslovak Academy of Sciences, Ondřejov). Bull. Astron. Inst. Czech., 15: 34-7(1964).

The measurement of the effective H_α-line width and the simultaneous photographs of flare spectra carried out at the Ondřejov Observatory allowed the revision of the limit intensity at which the contrast between the H_α emission and absorption lines disappears. This intensity is found to be in the range of 10–15% of the background absorption profile, substantially higher than the 5% given by Ellison (1952). The limit intensity increases with the distance from the line center and is systematically higher at the red wing than at the blue one. (auth)

9846 ELECTRON TEMPERATURE AND b_n VALUES IN FLARES. Z. Švestka (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 15: 38-41(1964).

The method of determining T_e as a limit of excitation temperature $T_\alpha(s \rightarrow r)$ for increasing quantum numbers s and r, applied to the flares of August 7, 1960 and July 30, 1958, is verified, and it is shown that it can be applied for conditions in interior parts of the flares. In surface layers of flares the deviations from thermodynamic equilibrium are more pronounced, and the method is not successful. The Balmer decrement is used to estimate the relative values of b_n factors in the flares discussed. With $n_e = 3$ or 6.10^{13} cm^{-3} for the flare of August 7, 1960, the concentration of two-quantum atoms n_2 is found to be on the order of 10^9 cm^{-3}, leading to a fictive geometrical thickness of several or several tens of kilometers. Thus the method applied presents further evidence of the filamentary structure of flares. (auth)

9847 CLASSIFICATION OF SOLAR RADIO STORMS IN THE METRE RANGE AND THEIR FREQUENCY 1959-1961. A. Tlamicha, L. Krivsky, and J. Olmr (Astronomical Inst., Czechoslovak Academy of Sciences, Ondřejov). Bull. Astron. Inst. Czech., 15: 49-52(1964).

A classification is presented of solar noise storms in the meter range (λ = 130 cm, f = 231.00 Mc), registered with a radio telescope at the Observatory of Ondřejov during 1959–1961. Five selected types of storms are described. The classification was based on the behavior of the base level and on the intensity and grouping of the bursts during the storm. The frequency of the storm types in individual years is given. The relation between the number of all noise storms during the three years and the phase of the solar activity is indicated. (auth)

9848 ON THE FLARE OF 1956 AUGUST 31 CONNECTED WITH THE EJECTION OF COSMIC RAY AFTER Y-SHAPED PHASE. L. Krivsky (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 15: 75-6(1964).

During the flare of power 3 on Aug. 31, 1956, McCracken (1959) determined a 2% increase of cosmic radiation on the earth. In the beginning of its evolution this flare passed through phase Y, as also occurred with previous analogous flares accompanied by cosmic radiation (Krivsky 1963). This and other cases lead to the conclusion that the emission of cosmic radiation proceeds when, in the period of the flare Y phase, the first large maximum of the solar radioburst appears simultaneously in the cm, dm, and m ranges. An explanation is given of the reason for this relatively small increase of cosmic radiation. In the other moving emitted filament of the flare, constituting one shoulder of the fork of the Y form, an oblique direction of motion can be assumed. (tr-auth)

9849 CONTRIBUTION TO THE PROBLEM OF THE ORIGIN OF NOVAE AND PLANETARY NEBULAE. L. Kohoutek (Astronomical Inst., Czechoslovak Academy of Sciences, Prague). Bull. Astron. Inst. Czech., 15: 81-90(1964).

A hypothesis is proposed for the formation of planetary nebulae from fast and very fast novae. It is derived from examinations of the effect of the corpuscular flux in the stellar atmosphere, divided into regions H II and H I, and from the study of characteristics common to novae and planetary nebulae. If the corpuscular flux attains high velocities, the external layers of the stellar atmosphere, which form the gaseous, rapidly expanding envelope of the nova, may be followed by the internal atmospheric layers which expand at a low velocity and, according to the hypothesis, represent the planetary nebula in rudimentary state. (auth)

9850 CORPUSCULAR AND PROTON CLOUD FROM FLARE AS POSSIBLE SOURCE OF RADIO EMISSION IN DM, M, DEKA-M AND KM RANGE. L. Krivsky (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 15: 115-17(1964).

On the basis of the example of the large radio flare at 37 cm, 56 cm, 10 m, and probably also 11 km, on Sept. 16, 1963, after a large solar flare, it is shown that apparently this mixture of radio waves is emitted from interplanetary space (from the region of the magnetosphere of the sun or earth) by a corpuscular or proton cloud ejected from the sun. The existence of this phenomenon could be verified by satellites, which would identify solar radio emission in the range from decimeter to very long waves during the course of several hours after a large solar flare. (tr-auth)

9851 TIME VARIATION OF ELECTRON DENSITY IN A LARGE SOLAR FLARE. L. D. de Feiter and Z. Svestka (University Observatory "Sonnenborgh," Utrecht and Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 15: 117-18(1964).

The electron density in the flare of July 12, 1961, was calculated from the half width of the H_{10}-H_{12} lines of the Balmer series. Seven spectra in all were taken during the flare time from 10 hr 27 min to 10 hr 45 min, so that a measurement of flare electron density with time was obtained. (tr-auth)

9852 SOLAR-FLARE ORIGIN AND NATURE OF THE RADIATION INCREASE RECORDED BY EXPLORER IV ON AUGUST 25, 1958. L. Krivsky (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 15: 131-3(1964).

The extraordinary radiation increase of short duration on August 25, 1958, from 1754 till 1755 UT, as recorded by scintillation counter on satellite 1958ϵ (altitude 600 km, 144°E, 49°N, geomagnetic latitude +39°), illuminated by the sun, was a γ emission that originated in the initial stage of a 1+ flare. The source and nature of the radiation burst originally could not be determined by the Japanese scientists, because the flare was overlooked during evaluation and thus was not listed. (auth)

9853 CATALOGUE OF 231 Mc/s SOLAR RADIO NOISE STORMS (ONDŘEJOV 1959–1961). A. Tlamicha and J. Olmr (Astronomical Inst., Czechoslovak Academy of Sciences, Ondřejov). Bull. Astron. Inst. Czech., 15: 133-5(1964).

Complete lists are given of solar radio noise storms on the 130 cm wavelength recorded at the Astronomical Institute Observatory, Ondřejov, during 1959, 1960, and 1961. These solar radio noise storms are divided into 5 groups N_A, N_B, N_C, N_D, N_E (A. Tlamicha et al., 1963). The possibility of their relation to spectral classification is given in a table. (auth)

9854 BROADENING OF HIGH BALMER LINES IN FLARES AND PROMINENCES. Z. Svestka (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 15: 162-3(1964).

Half widths of the H_{10}–H_{14} lines of the Balmer series, measured in the spectrum of an active prominence and three flares, are compared. The differences in processes of broadening of the Balmer-series lines in flares and prominences are derived from the different variations of the half width with the ordinal number of the line. The lines of the studied prominence were broadened most of all by the Doppler effect of nonthermal origin, with characteristic velocities of 21 to 23 km/sec at low electron density. (tr-auth)

9855 A SHORT NOTE ON THE DETERMINATION OF THE EFFECTIVE H_α— LINE WIDTH IN CHROMOSPHERIC FLARES. L. Fritzova-Svestkova (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 15: 163-4f(1964).

Comparison of simultaneous measurements of the effective width of the H_α line in old and new spectrohelioscopes showed that some of the most important factors in these measurements are the individual abilities of the observers. (tr-auth)

9856 TRAJECTORIES OF PARTICLES EJECTED FROM L_1 IN RW TAURI. M. Plavec (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov), L. Sehnal, and J. Mikulas. Bull. Astron. Inst. Czech., 15: 171-8 (1964).

Trajectories of discrete particles ejected from the first

Lagrangian point with different speeds and directions were calculated by numerical integration. Three-dimensional orbits are also considered. The underlying Roche model of a close binary with a mass ratio of 0.2151 fits Grant's model of RW Tauri. Several orbits were found which can contribute to the observed ring around the primary star; they require ejection velocities of the order of 100 km/sec, as well as definite directions of ejection. Thermal diffusion cannot contribute directly to the ring; a kind of prominence must be assumed. Ring-forming orbits are much less probable for ejections directed away from the orbital plane of the system. The ring is probably a transient phenomenon, although its lifetime may be favorably affected by collisions between particles. The point L_1 appears to be less important for the dynamics of the gaseous streams than is sometimes thought. (auth)

9857 ZIRCONIUM ABUNDANCES IN METEORITES AND IMPLICATIONS TO NUCLEOSYNTHESIS. R. A. Schmitt (General Atomic Div., General Dynamics Corp., San Diego, Calif.), E. Bingham, and A. A. Chodos. Geochim. Cosmochim. Acta, 28: 1961-79(Dec. 1964).

The atomic abundance of Zr was established at 16 ± 5 Zr atoms/10^6 Si atoms in seventeen ordinary chondrites, which agreed well with Aller's (1962) solar value of 14 Zr atoms/10^6 Si atoms. Apparently, fractionation of Zr occurred within the chondritic family, since 22 ± 3 Zr atoms/10^6 Si atoms were observed in seven Type II and Type III carbonaceous chondrites. Zr was enriched in four Ca-rich achondrites by a factor of five, which was consistent with other trace-element enrichments. Zr may be depleted in Ca-poor achondrites and pallasitic olivines. The low Zr abundance in chondrites, coupled with Rb, Sr, Y, and Mo chondritic abundances, indicated ~50% enhancement of the odd-A mass distribution at A = 89 due to the neutron-shell closure. Abundance values of Zr and other nearby elements indicated ^{56}Fe seed nuclei were exposed to different neutron fluxes. The atomic ratio Zr/Hf of 100 in meteorites compared with 106 in the terrestrial crust indicated no serious fractionation between these two very similar chemical elements. (auth)

9858 TRACE ELEMENT ABUNDANCES AND THE CHONDRITIC EARTH MODEL. S. R. Taylor (Australian National Univ., Canberra). Geochim. Cosmochim. Acta, 28: 1989-98(Dec. 1964).

The proportions of continental and oceanic crust relative to mantle and core are given. Allowance was made for oxidation of core material and the correction added 15% to the mass of the primitive Earth (excluding volatiles). Chondritic abundances for lithophile and siderophile elements were selected mainly from H group chondrites. The chalcophile elements were not considered. Crustal abundances from Taylor (1964) were used as the basis for calculating the concentration of elements in the crust for an Earth of chondritic composition. It was concluded that the Earth contains about twice as much U and Th and about one third the alkali metal content of chondrites. Fractionation processes affected both the parent material of chondrites and the Earth. The geochemical fractionation of the Earth was considered to be due to the strong upward concentration of elements unable to enter into 6-fold co-ordination with oxygen in close-packed structures. All the heat-producing elements are probably above a depth of 400 km and are probably closer to the surface. (auth)

9859 NOBLE GASES IN THE BRUDERHEIM CHONDRITE. O. K. Manual and M. W. Rowe (Univ. of Arkansas, Fayetteville). Geochim. Cosmochim. Acta, 28: 1999-2003 (Dec. 1964).

The abundance pattern and isotopic composition of all the noble gases in the Bruderheim chondrite were studied. Data are presented in tables and graphs. (M.C.G.)

9860 DETECTABILITY OF DISTURBANCES IN THE SOLAR WIND. F. C. Michel (Rice Univ., Houston, Tex.). J. Geophys. Res., 70: 1-7(Jan. 1, 1965).

A supersonic disturbance in nonionized air can not be directly detected by an observer outside the shock wave. The analogous limitation on detection of disturbances in the solar wind is discussed, and the limiting Mach angle is computed in a convenient coordinate system. Recent interpretations of the Imp-1 data (i.e. observation of the moon's wake) are discussed in view of the above restrictions. (auth)

9861 ELECTRON ACCELERATION AND PLASMA INSTABILITIES IN THE TRANSITION REGION. F. L. Scarf, W. Bernstein, and R. W. Fredricks (Space Technology Labs., Redondo Beach, Calif.). J. Geophys. Res., 70: 9-20(Jan. 1, 1965).

It is proposed that after a solar wind enhancement the wind-magnetosphere interface becomes unstable with respect to production of ion acoustic waves. The high frequency electric oscillations then allow plasma to diffuse across the magnetic field, and the waves interact with the electron population via the cyclotron resonance. A small fraction of the electrons are accelerated to kev energies, and the energy distribution function is also distorted in the thermal region. Ultimately, the solar wind becomes locally subsonic with respect to the ion acoustic wave speed, and the waves travel upstream, spreading the region of electron thermalization. Various stages in this relaxation process are described, and the theoretical predictions are compared with available experimental results. (auth)

9862 NUMERICAL ESTIMATES OF SUPERTHERMAL ELECTRON PRODUCTION BY ION ACOUSTIC WAVES IN THE TRANSITION REGION. R. W. Fredricks, F. L. Scarf, and W. Bernstein (Space Technology Labs., Redondo Beach, Calif.). J. Geophys. Res., 70: 21-8(Jan. 1, 1965).

The ion acoustic wave-electron gyrofrequency resonance is examined quantitatively, and the results are used to discuss the plausibility of invoking this mechanism to explain the production of E > 30 kev electrons in the solar wind-geomagnetic field transition region. The wave is represented by a potential distribution $\phi = \phi_0 \sin (k \cdot r - \omega t + \psi)$ with $0 < \omega < \Omega_p$ (ion plasma frequency), $0 < k < k_D$ (Debye wave number), and ψ, a stochastic phase variable associated with nonlinear effects. It is estimated that $e\phi_0$ may approach 35% of the incident wind energy in localized regions, and sample numerical solutions to the equations of motion are used to show that the maximum electron energy derived from this resonance is of the order of $130e\phi_0$. The resonance conditions which lead to production of significant (30 to 80 kev) electron fluxes are discussed, and one favorable magnetic field configuration is described. (auth)

9863 RARE GAS ISOTOPE CONTENTS AND K–Ar AGES OF MINERAL CONCENTRATES FROM THE INDARCH METEORITE. O. A. Schaeffer (Brookhaven National Lab., Upton, N. Y.), R. W. Stoenner, and E. L. Fireman. J. Geophys. Res., 70: 209-13(Jan. 1, 1965). (BNL-8453)

Rare gas contents and isotopic abundances were measured for mineral separates from the enstatite chondrite Indarch. A cosmic ray exposure of 11 million years was estimated. There is an indication of a higher temperature during the time the meteorite was exposed to cosmic rays than during its preceding history. K–Ar ages from 2.4 to 4.4 billion years were found for the different mineral concentrates. The ^{129}Xe/^{132}Xe ratio varies from 1.7 to 4.9 and is 2.1 for the troilite fraction, in which I and Te might be expected; it is concluded that either Xe was lost from troilite in its early history or the ^{129}Xe is not associated in Indarch with I or Te. (auth)

9864 COMPARISON OF $Cl^{36}-Ar^{36}$ AND $Ar^{39}-Ar^{38}$ COSMIC RAY EXPOSURE AGES OF DATED FALL IRON METEORITES. O. A. Schaeffer (Brookhaven National Lab., Upton, N. Y. and Max-Planck-Institut für Kernphysik, Heidelberg) and D. Heymann. J. Geophys. Res., 70: 215-24(Jan. 1, 1965). (BNL-8256)

The cosmic ray exposure ages of six octahedrites and of the iron phase of one mesosiderite were measured. Five of these meteorites are dated falls. From the results there is support for a previous suggestion of two major collisions in space, one between 600 and 700 million years ago, the other between 300 and 400 million years ago. The cosmic ray exposure age of the mesosiderite Estherville, 64 million years, is more typical of a stone meteorite than of an octahedrite. It is found that the meteorite Norfolk is a find, not a fall, as was suspected. (auth)

9865 MAGNETIC SHIELDING OF THE LUNAR SURFACE FROM THE SOLAR WIND AS A FUNCTION OF LUNAR MAGNETIC MOMENT. L. Aronowitz and S. N. Milford (Grumman Aircraft Engineering Corp., Bethpage, N. Y.). J. Geophys. Res., 70: 227-9(Jan. 1, 1965).

Solar-wind effects on the lunar surface structure and atmosphere can not occur if a lunar magnetic field is present, shielding the solar wind. Experiments demonstrating (Imp 1) and failing to discover (Lunik 2) a lunar magnetic field are discussed. The lunar magnetospheric boundary distance is calculated as a function of a postulated lunar magnetic field, for a solar wind particle density of 5 cm^{-3}, using scaled calculations of the earth's magnetosphere. (M.J.T.)

9866 SOLUTION OF EINSTEIN'S FIELD EQUATIONS FOR A ROTATING, STATIONARY, AND DUST-FILLED UNIVERSE. James P. Wright (Univ. of Wisconsin, Madison). J. Math. Phys. (N. Y.), 6: 103-5(Jan. 1965).

The solution of Einstein's field equations, $R_{ij} - \frac{1}{2}g_{ij}R = 8\pi\kappa\rho u_i u_j + \lambda g_{ij}$, for a line element of the form $ds^2 = (dx^0)^2 - \delta^2(x^1)(dx^1)^2 + 2\beta(x^1)dx^0dx^2 - \gamma^2(x^1)(dx^2)^2 - \alpha^2(x^1)(dx^3)^2$ is found. The density, ρ, may be a function of position, and the cosmological constant λ is not necessary in order to have a finite density. The solution reduces to that of Gödel if the variable α is constant. If the requirement for an empty universe is made ($R_{ij} = 0$), the solution is conformally flat. The characteristics of the conformal curvature tensor are also obtained. (auth)

9867 ELECTRON DENSITIES IN GASEOUS NEBULAE. L. B. Davis, F. Ring, and M. F. Selby. Monthly Notices Roy. Astron. Soc., 128: 399-418(May 1964).

The electron density in a nebula may be determined from the ratio of the intensities of the O [II] lines 3726, 3729 Å. Two instruments were designed to measure O [II] intensity ratios. The first is a Fabry-Perot monochromator preceded by an interference filter. The second is a multislit photoelectric grating spectrometer. In the latter case a full description is given of the optical factors limiting the number of slits. Both instruments were used with the 50-in. telescope at Asiago in observations of diffuse and planetary nebulae. The intensity ratios are compared with those obtained by more conventional techniques. (auth)

9868 FURTHER OBSERVATIONS OF THE ZODIACAL LIGHT FROM A HIGH ALTITUDE STATION AND INVESTIGATION OF THE INTERPLANETARY PLASMA. III. PHOTOELECTRIC MEASUREMENTS OF POLARIZATION. D. W. Beggs (The Observatories, Cambridge, Eng.), D. E. Blackwell, D. W. Dewhirst, and R. D. Wolstencroft. Monthly Notices Roy. Astron. Soc., 128: 419-30(May 1964).

If, as suggested by Huruhata, the degree of polarization of the night sky at high ecliptic latitudes is low (< 0.3 per cent), its value can place a useful upper limit on the electron density in regions away from the plane of the ecliptic. The polarization of the night sky was measured at the Chacaltaya High Altitude Observatory using a polarimeter incorporating an electro-optic modulator. The mean polarization observed in the region of the north ecliptic pole is 4.5 per cent, but the individual values vary significantly from night to night; this variation is attributed to changes in the brightness of the night sky. The true mean value, corrected for the effect of scattered light, is 3.9 per cent; it is too high to set a useful upper limit on the electron density. The significance of the observations in terms of scattering by an interplanetary and a geocentric dust cloud is discussed. (auth)

9869 THE DIAMETER OF QUASI-STELLAR RADIO SOURCES. I. P. Williams (Univ. of Reading, Eng.). Phys. Letters, 14: 19-21(Jan. 1, 1965).

The properties of a class of optical objects whose position appears to coincide with certain radio sources in the 3C catalog are discussed. The properties of interest are the suggested radius of about 10^3 light years and an observed variation in the light intensity of ~30% in one year. A sinusoidal fluctuation superimposed on a steady source is assumed, and the observed effects are calculated at a large distance. It appears that the observed variation in the brightness of 3C 48 (and the other quasi-stellar radio sources to a lesser extent) implies that the object radius must be much smaller than the suggested value of 10^3 light years. (C.E.S.)

9870 COOLING OF A NEUTRON STAR BY THE "URCA" PROCESS. Arrigo Finzi (Università, Rome). Phys. Rev., 137: B472-?(Jan. 25, 1965).

The energy loss of a degenerate neutron gas by the Urca process is calculated to be $7.36 \times 10^4(T/10^9)^8$ erg g^{-1} sec^{-1} for a density of 6×10^{14} g cm^{-3}. It follows that the Urca process alone was able to cool the core of the neutron star created in the type I supernova of 1054 A.D. to a temperature around 5×10^8°K. The emission power of the star should then be about one order of magnitude smaller than that of the x-ray source discovered recently in the Crab nebula; the source can not be interpreted therefore simply as the thermal radiation of the star. This conclusion is consistent with the result of a recent experiment performed by the method of lunar occultation, indicating an angular size of the source comparable to that of the Crab nebula. A more refined experiment performed by the same method should make it possible to decide whether a neutron star exists in the Crab nebula. (auth)

9871 THE REACTION PRODUCTS OF SOLAR HYDROGEN AND COMPONENTS OF THE HIGH ATMOSPHERE OF VENUS—A POSSIBLE SOURCE OF THE VENUSIAN CLOUDS. R. C. Robbins (Stanford Research Inst., Menlo Park, Calif.). Planetary Space Sci., 12: 1143-6(Dec. 1964).

A theory concerning the origin and composition of the Venusian clouds is presented. Hydrogen from the solar wind reacts with components of the upper atmosphere, principally CO and N_2. The initial reaction products are protected upon entering the dark hemisphere of Venus, and the long night (~1400 hr) provides ample time for polymerization, condensation, and subsidence to lower levels of the atmosphere. A continuous source from above, coupled with regenerative processes from the hot regions below, fulfills the requirements for maintaining a perpetual cloud layer. (auth)

9872 OBSERVATIONAL NEUTRINO ASTRONOMY. John N. Bahcall (California Inst. of Tech., Pasadena). Science, 147: 115-20(Jan. 8, 1965).

Experiments to be performed in 1965 involving neutrinos from the sun, from the decay of cosmic-ray secondaries, and from strong radio sources are described. The foundations of the theoretical predictions and the significance of the experiments are emphasized. The role of neutrinos in cosmology are briefly discussed. (P.C.H.)

9873 DECIMETER RADIO FLUX FROM TAURUS A. V. S. Troitskii, N. M. Tseitlin, and V. A. Porfir'ev (Lobachevskii Univ., Gorki, USSR). Soviet Astron. AJ (English Transl.), 8: 354-8(Nov.-Dec. 1964). Translated from Astron. Zh., 41: 446-51(May-June 1964).

Precision measurements of the radio-emission flux from the discrete source Taurus A were made by the artificial moon method at wavelengths of 25.1, 34.25, 35.9, 42.4, and 54.4 cm. The procedure is described and the results presented. (auth)

9874 ACCELERATION BY RADIATION AND THE GENERATION OF FAST PARTICLES UNDER COSMIC CONDITIONS. III. TIME VARIATIONS IN THE INTENSITY OF RADIO SOURCES. A. K. Gailitis and V. N. Tsytovich (Lebedev Inst. of Physics, Moscow). Soviet Astron. AJ (English Transl.), 8: 359-67(Nov.-Dec. 1964). Translated from Astron. Zh., 41: 452-63(May-June 1964).

An analysis is given of time variations in the radio-emission spectrum of discrete sources, particularly variations in the spectral index due to radiation acceleration. Some problems in the origin of cosmic electrons are discussed. (auth)

9875 DIAMAGNETIC EJECTION OF GAS CONDENSATIONS FROM SUNSPOT REGIONS. M. A. Livshits and S. B.

Pikel'ner (Inst. of Geomagnetism, Ionosphere, and Radio Wave Propagation, Academy of Sciences, USSR and Shternberg State Astronomical Inst., USSR). Soviet Astron. AJ (English Transl.), 8: 368-75(Nov.-Dec. 1964). Translated from Astron. Zh., 41: 464-72(May-June 1964).

The ejection of condensations usually observed near chromospheric flares is apparently linked to diamagnetic forces. Calculations show that such an ejection requires an internal field commensurate with the external field of the spot at the given height. The initial density of these condensations (referred to a height of 1000 km) which may be expelled at observable velocities can reach roughly 3×10^{15} to 10^{16} cm^{-3}. The manner in which heating of the gas compensates for the cooling accompanying expansion is discussed. The appearance of the condensations is apparently due to the formation and separation of loops on lines of force of the spot field, as a result of perturbations set in motion by the flare. (auth)

9876 ENERGY BALANCE IN THE TRANSITION REGION BETWEEN THE CHROMOSPHERE AND CORONA. M. A. Livshits (Inst. of Terrestrial Magnetism, Ionosphere, and Radio-Wave Propagation, Academy of Sciences, USSR). Soviet Astron. AJ (English Transl.), 8: 376-83(Nov.-Dec. 1964). Translated from Astron. Zh., 41: 473-81(May-June 1964).

Energy losses from different levels of the outer solar atmosphere were calculated on the basis of observations of lines in the extreme ultraviolet. The model of the transition region between the chromosphere and corona proposed by Ivanov-Kholodnyi and Nikol'skii was used to normalize ionization temperatures to height. In the case of an undisturbed region under consideration, it is shown that the dissipation of weak shock waves can provide the necessary inflow of energy. The heat flow from the corona to the chromosphere is apparently strongly reduced because of the motion of matter upwards from the solar surface. (auth)

9877 SPECTRA OF CORONAL IONS CONNECTED WITH THE sp^3 CONFIGURATION. A. A. Nikitin (Leningrad State Univ.). Soviet Astron. AJ (English Transl.), 8: 384-6(Nov.-Dec. 1964). Translated from Astron. Zh., 41: 482-4(May-June 1964).

The energies of ^5S metastable states and some other levels of $2s2p^3$ and $3s3p^3$ configurations are estimated by semi-empirical methods. The wavelengths and transition probabilities for forbidden transitions $s^2p^23P-sp^3\ ^5S$ are estimated in the ultraviolet spectra of coronal ions belonging to the $2s^22p^2$ and $3s^23p^2$ isoelectronic sequences. (auth)

9878 CONTINUOUS SPECTRA OF HELIUM WHITE DWARFS. A. K. Kolesov (Leningrad State Univ.). Soviet Astron. AJ (English Transl.), 8: 387-93(Nov.-Dec. 1964). Translated from Astron. Zh., 41: 485-93(May-June 1964).

Model atmospheres of white dwarfs with surface temperatures T_0 = 12,000, 15,000, 20,000, and 30,000 and gravitational accelerations $g = 10^6$, 10^8, and 10^{10} cm/sec^2 were computed. Atmospheres of pure helium are assumed. It is shown that convection is important in the atmospheres of helium white dwarfs, its role increasing with decreasing temperature. The spectral energy distribution at 3000 to 6500 Å is determined. A dependence between U−V and the surface temperature is found. The temperatures of D0 and DB type white dwarfs are derived on the basis of observational data on U−V indices and the dependence between U−V and T_0. The influence of lines on the color indices of these stars is discussed. (auth)

9879 STATIONARY MOTIONS IN MAGNETOGASODYNAMICS. M. K. Zhekamukhov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 47-51(May-June 1964). (In Russian)

Effects of gravitational and magnetic forces on cosmic gas flow were studied considering gaseous sphere rotation in a magnetic field and charged particle motion near the solar surface. (R.V.J.)

9880 THE POLARIZATION OF PROMINENCE HELIUM I D_3 EMISSION. Charles Latif Hyder. Thesis, Boulder, Colo., Univ. of Colorado, 1964. 144p.

The polarization of prominence emission in the HeI D_3 multiplet is derived as a function of the excitation temperature in D_3, the height of the prominence above the solar limb, and the prominence magnetic field. The analysis is by a perturbation treatment of the equations of statistical equilibrium. The theoretical results are compared with Lyot's observational results, which restrict the ranges of excitation temperature and magnetic field. All of the effects observed by Lyot may be explained by the presence of a magnetic field of a filament that has been distorted by differential rotation of the solar atmosphere. The strengths of prominence magnetic fields may range between 0 and 200 gauss. Resonance polarization and impact polarization effects may be used to infer anisotropies and magnetic fields in other astronomical objects. The analysis is outlined and discussed. (Dissertation Abstr., 25: No. 3, Sept. 1964)

9881 MASS LOSS IN T TAURI STARS. Leonard Vello Kuhi. Thesis, Berkeley, Calif., Univ. of California, 1964. 101p.

The broad emission lines of hydrogen and CaII in the spectra of T Tauri stars are interpreted in terms of a simplified model for the mass loss phenomenon assumed to be taking place. The expanding envelope is taken to be spherically symmetric with the ejected atoms all having the same initial velocity and subjected only to gravitational forces. The emitting volume, essentially an HII region, is surrounded by an absorbing shell moving radially outward and producing the violet-displaced absorption components. Fitting computed line profiles to observed contours then gives the particle density at the surface of the star. Combining this value with estimates of the stellar temperature and radius gives the present rate of mass loss. For six representative stars with varying emission line strengths these rates range from 0.3 to 5.8×10^{-7} $M_\odot$ per year with an average of 3.7×10^{-8} $M_\odot$ per year. It is estimated that approximately 40% of the contracting stars may be losing mass, and that the total mass lost by a typical 1 $M_\odot$ star is of the order of 10% of its mass. A rather qualitative analysis of the effect of mass loss on the contractive stage of stellar evolution is made for both convective and radiative cases. It is found that the instantaneous rate of contraction increases in the presence of mass ejection and therefore that the star reaches the main sequence in a shorter period of time. (Dissertation Abstr., 25: No. 3, Sept. 1964)

9882 THE ABUNDANCE PATTERN AND ISOTOPIC COMPOSITION OF NOBLE GASES IN THE FAYETTEVILLE METEORTIE. Oliver Keith Manuel. Thesis, Little Rock, Ark., Univ. of Arkansas, 1964. 106p.

A high-sensitivity mass spectrometer for noble gas analysis was assembled and employed to study the isotopic composition and total abundance pattern of noble gases in the Fayetteville meteorite. The dark regions of the Fayetteville meteorite were found to have a greater noble gas content than any known meteorite, whereas the light regions were found to be depleted in noble gases and to have a gas abundance pattern indicative of strong mass fractionation, as has been reported for typical chondrites. A model for the parent body of meteorites was derived from the noble gas abundances and was shown to be consistent with current results of other laboratories. A comparison of the noble gases in the two regions was used to demonstrate the effects of spallation, fission, and radioactive decay on the isotopic composition of the noble gases in the light regions. These isotope alterations were employed to determine the cosmic-ray exposure age, the time interval between element synthesis and formation of the meteorite, and the gas retention age of the Fayetteville meteorite. (Dissertation Abstr., 25: No. 3, Sept. 1964)

Atomic Physics

Refer also to abstract 10273.

9883 (ANL-6931) ANALYTIC SELF-CONSISTENT FIELD WAVE FUNCTIONS AND COMPUTER PROPERTIES FOR HOMONUCLEAR DIATOMIC MOLECULES.

Arnold C. Wahl (Argonne National Lab., Ill. and Chicago. Univ. Lab. of Molecular Structure and Spectra). Aug. 1964. Contract W-31-109-eng-38. 41p. Dep.; $2.00 (OTS).

The analytic and computational framework on homonuclear diatomic molecules for Hartree-Fock-Roothaan calculations is presented. Several approaches to calculating the wave function are sketched, as well as methods of computing molecular properties from the wave function. The efficient organization of these calculations for existing digital computers is emphasized. Typical results obtained through the application of the programs and techniques developed are presented for the fluorine molecule. (auth)

9884 (JINR-P-1868) DINAMICHESKAYA POLYARIZATSIYA PROTONOV V MISHENI VOL'SHOGO. (Dynamic Proton Polarization in a Large-Volume Target). V. I. Lushchikov and Yu. V. Taran (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Neutron Physics). 1964. 4p. Dep. (mn).

In a 28-cm^3 target consisting of lanthanum magnesium nitrate monocrystals with a 0.4% admixture of ^{142}Nd, an enhancement by a factor of 500 is obtained for the proton polarization in the crystallization water. The magnetic field was 9.9 kOe and the temperature 1.5°K. This corresponds to a proton polarization of 35%. The solid-effect method was used. (auth)

9885 (KN-674-63-7(R)) ION-ION AND ELECTRON-ION RECOMBINATION. Scientific Report No. 1. Earl W. McDaniel (Kaman Aircraft Corp. Kaman Nuclear Div., Colorado Springs). Aug. 1, 1963. Contract AF19(628)-209. 106p. (AFCRL-63-867; AD-420255). $9.60(OTS).

The recombination coefficient is defined and expressions for the time dependence of the charge carrier number densities in terms of this coefficient are derived. The mechanisms and theories of recombination are discussed and equations for the recombination coefficient are derived. Finally, experimental methods and data are presented, and comparisons are made with theoretical predictions. (auth)

9886 (NSA-NRC-PUB-1133) STUDIES IN PENETRATION OF CHARGED PARTICLES IN MATTER. Nuclear Science Series Report No. 39. (National Research Council. Committee on Nuclear Science). 1964. 393p. $7.00.

Fourteen papers are included; separate abstracts have been prepared for 10. Four papers were previously abstracted in NSA; 18:10636, 10637, 19:8004, and 8005. (T.F.H.)

For abstracts of individual papers see: 9887, 9888, 9889, 9890, 9891, 9892, 9893, 9894, 9895, and 9896.

9887 (NSA-NRC-PUB-1133(p.1–16)) THOMAS-FERMI APPROACH AND SIMILARITY IN ATOMIC COLLISIONS. Jens Lindhard (Aarhus, Denmark. Universitet. Fysiske Institut).

The significance of similarity in atomic collisions and stopping problems is discussed. Similarity properties are primarily connected with dynamic Thomas-Fermi treatments. The discussion deals mainly with the basic physical picture, but not with details as regards measurements and applications. Deviations from similarity are treated, as well as possibilities of improving incomplete descriptions of collision processes. Collisions between ions and atoms are analyzed roughly, and are divided into two major groups. One group relates to the quantal perturbation case, where the phenomena may be described in terms of properties of the medium only. This case is discussed in some detail. Significant properties are, for example, dipole spectra of atomic systems, behavior of stopping at lower velocities, and applicability of free electron gas picture in atomic dynamics. The second group of collisions relates to ions of relatively low velocity where collisions between ions and atoms may become nearly elastic, the energy loss being largely kinetic energy of recoil atoms. For such collisions, classical mechanics may be used; similarity properties are based on this circumstance, and become different from those of the first group. Inelastic effects are also of importance and may be roughly estimated, as discussed briefly. (auth)

9888 (NAS-NRC-PUB-1133(p.17-37)) A CRITICAL REVIEW OF EXPERIMENTAL STOPPING POWER AND RANGE DATA. H. Bichsel (University of Southern California, Los Angeles).

Of the many experimental data available, a few have been selected as being especially comprehensive or accurate for an evaluation in terms of the Bethe theory. The choice has been restricted to data pertaining to the penetration of hydrogen and helium ions. The discrepancies found in the experimental data discourage reliance on a single data point for the determination of the parameters necessary for the theory (e.g., the I-value) and also make it appear highly desirable to encourage further intensive experimental study of the charged particle interaction. A discussion is given of the theory, including some comments about the shell corrections. This discussion is followed by detailed discussion of several experiments and a detailed treatment of aluminum and copper data. (auth)

9889 (NAS-NRC-PUB-1133(p.39–47)) ON THE EXPERIMENTAL VERIFICATION AND DETERMINATION OF PARAMETERS OF STOPPING-POWER THEORY. J. E. Turner (Oak Ridge National Lab., Tenn.). (ORNL-P-385)

Stopping power and range measurements are reviewed from the standpoint of general verification of stopping-power theory and the determination of the parameters of the theory. Certain experiments stand out in this respect in providing coverage of a wide range of chemical elements and/or incident particle energies. Experiments are analyzed on the basis of information they furnish, particularly with respect to mean excitation energies, I, and shell corrections. The value I = 163 ± 1 ev for aluminum appears to be well established, and is taken as an anchor point in the analysis of data. In general, high-energy experiments (e.g., with protons of several hundred Mev) furnish direct information about mean excitation energies. Experiments at lower energies provide information on the variation of shell corrections with incident particle energy and with atomic number. The information provided collectively by the experiments discussed is displayed in summary form. (auth)

9890 (NAS-NRC-PUB-1133(p.49-67)) CONTRIBUTIONS TO THE THEORY OF SHELL CORRECTIONS. U. Fano (National Bureau of Standards, Washington, D. C.) and J. E. Turner (Oak Ridge National Lab., Tenn.). (ORNL-P-369)

Sum rules pertaining to the inelastic form factor are calculated and applied to the evaluation of shell corrections to the stopping-power formula, to order $1/v^4$ in the velocity of the incident particle. Details are given pertaining to the evaluation of the shell corrections. Comments are presented regarding the possible generality of equipartition rule. (auth)

9891 (NAS-NRC-PUB-1133(p.69–98)) MULTIPLE-SCATTERING CORRECTIONS FOR PROTON RANGE MEASUREMENTS. Martin J. Berger and Stephen M. Seltzer (National Bureau of Standards, Washington, D. C.).

Three approximate methods are described that may be used to calculate differential and integral distributions of projected range, median ranges, and curves of ionization versus depth (Bragg curves) for protons traversing thick absorbers. One of the methods is based on the application of a multiple-scattering detour distribution, and another makes use of random sampling. Two types of statistical fluctuations are taken into account: energy loss straggling in collisions with atomic electrons, and the "wiggiliness" of the track (detours) due to multiple Coulomb scattering by atoms. All three methods were used to extract the values of the proton c.s.d.a. (continuous slowing-down approximation) range, r, and of the mean excitation energy, I_{adj}, of the medium from measured Bragg curves in lead and copper. They give results for r and I_{adj} that are in good agreement with each other, but do not account entirely for shape of the measured Bragg curves. (auth)

9892 (NAS-NRC-PUB-1133(p.99-101)) VALUES OF I AND I_{adj} SUGGESTED BY THE SUBCOMMITTEE. J. E. Turner (Oak Ridge National Lab., Tenn.). (ORNL-P-386)

Values of I/Z and I_{adj}/Z are suggested for the chemical elements in the form of graphs representing these quantities as functions of Z. (auth)

9893 (NAS-NRC-PUB-1133(p.173-86)) PASSAGE OF HEAVY IONS THROUGH MATTER. II. RANGE-ENERGY CURVES. Lee C. Northcliffe (Yale Univ., New Haven).

Semi-empirical range-energy relationships are presented for heavy ions with energies up to 10 Mev/amu in various solid materials. Range-energy curves for ^{4}He, ^{11}B, ^{12}C, ^{14}N, ^{16}O, ^{19}F, and ^{20}Ne ions in carbon, aluminum, nickel, silver, and gold calculated from smoothed semi-empirical stopping-power curves by numerical integration are compared with available range and energy-loss data and with other calculations. In addition, range-energy relationships in aluminum inferred from experimental energy-loss data for representative heavy ions in aluminum are presented for ions of various isotopes of helium, lithium, beryllium, boron, carbon, nitrogen, oxygen, fluorine, neon, sodium, magnesium, aluminum, and silver. (auth)

9894 (NAS-NRC-PUB-1133(p.187-203)) ENERGY-LOSS STRAGGLING OF PROTONS AND MESONS: TABULATION OF THE VAVILOV DISTRIBUTION. Stephen M. Seltzer and Martin J. Berger (National Bureau of Standards, Washington, D. C.).

The Vavilov distribution, which describes the energy-loss straggling of charged particles traversing a thin layer of matter, is tabulated. The distribution depends on the particle velocity and on a parameter, $\varkappa$, indicative of the ratio of the mean energy-loss over the pathlength considered to the largest energy-transfer possible in a single collision with an atomic electron. As $\varkappa \rightarrow 0$, the Vavilov distribution goes over into the Landau distribution; for $\varkappa \gtrsim 10$ it becomes Gaussian. Intermediate values of $\varkappa$ occur for protons and mesons of moderate velocity traversing very thin targets or for extremely fast particles in targets of moderate thickness. (auth)

9895 (NAS-NRC-PUB-1133(p.269-79)) ATOMIC AND IONIC PARTIAL STOPPING POWERS. Samuel K. Allison (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies).

The partial stopping power of a target material for an ion or an atom is the energy lost per target particle per cm^2 in all types of collisions in which the ion or the atom is the projectile, with the exception of those collisions in which the projectile leaves with its charge changed. Partial atomic stopping powers of target gases for atoms are measured by imposing a strong transverse magnetic field on the stopping cell. For partial ionic stopping-power measurements the ion beam is held in a circular orbit, closely defined by vanes and slits, as it traverses the stopping cell. The partial stopping powers ϵ_0(for He^0 transversing H$_2$ gas), ϵ_1(for He$^+$), and ϵ_2(for He^{++}) have been measured in the kinetic energy range 40 to 460 kev, and new measurements of the ordinary, or total, stopping power of H$_2$ gas for helium from 40 to 22 kev have been made. Using the known charge composition of He beams in H$_2$, it is possible to deduce the fraction of the stopping-power losses due to charge-changing collisions, and this varies from 37 percent at 140 kev to 27 percent at 400 kev. At 120 kev, the total energy-loss in completing the charge-changing cycle $He^+ \rightarrow He^0 \rightarrow He^+$ is 95 ± 9 ev, rising to 117 ± 10 ev at 160 kev. (auth)

9896 (NAS-NRC-PUB-1133(p.281-4)) A LIST OF CURRENTLY UNSOLVED PROBLEMS. U. Fano (National Bureau of Standards, Washington, D. C.).

Discussions of charged-particle penetration in matter have pointed up a number of unsolved problems. Some of these problems are of considerable importance and difficulty, so that their solution will require a major experimental or theoretical effort. Others are of lesser importance, and are easier to attack. It seems worthwhile to present a list of such problems, with reference to literature where their backgrounds are discussed in greater detail. (auth)

9897 (UCRL-7734) FORTRAN PROGRAMS USEFUL IN SCATTERING EXPERIMENTS. S. F. Eccles, H. F. Lutz, and J. Stevens (California. Univ., Livermore. Lawrence Radiation Lab.). June 19, 1964. Contract W-7405-eng-48. 36p. Dep.; $1.00(OTS).

FORTRAN programs are presented for calculating the geometrical factor that relates measured yield to differential scattering cross section in experiments using a gas target, and for calculating kinematic relationships for nonrelativistic nuclear particle collisions. The geometrical factor for gas scattering is calculated assuming two circular apertures define the scattered particles which enter the detector. The kinematic calculation includes, among many other quantities, the energy deposited in a detector by the scattered particle, after it has passed through a thin ΔE detector. Both codes are written for an IBM 7094 digital computer and the Livermore Monitor system. FORTRAN listings are given for each. (auth)

9898 (JPRS-27372(p.32-5)) CALCULATION OF SPLITTING OF GROUND STATES OF CaF$_2$ AND SrF$_2$ WITH IMPURITY OF Nd^{3+}. Wei-han T'an, Ching-yu Chao, Wei-min Sha, and Ch'ien-ho Chu. Translated from K'o Hsueh T'ung Pao, No. 8, 732-3(1964).

The cubic field matrices are calculated for CaF$_2$(Nd^{3+}) and SrF$_2$(Nd^{3+}), and are used to calculate the ground-state splitting of these crystals by the Nd-ion impurities. The calculated values are compared with experimental values. (T.F.H.)

9899 ANOMALOUS DISPERSION CORRECTIONS COMPUTED FROM SELF-CONSISTENT FIELD RELATIVISTIC DIRAC-SLATER WAVE FUNCTIONS. Don T. Cromer (Los Alamos Scientific Lab., N. Mex.). Acta Cryst., 18: 17-23(Jan. 10, 1965).

Anomalous dispersion terms, $\Delta f'$ and $\Delta f''$ were computed for elements number 10 through 98 for 5 commonly used x-ray wavelengths. Oscillator strengths were calculated from self-consistent field relativistic Dirac wave functions which included the potential Slater's approximate exchange contribution and Latter's self-interaction term. (auth)

9900 SCATTERING FACTORS COMPUTED FROM RELATIVISTIC DIRAC-SLATER WAVE FUNCTIONS. Don T. Cromer and J. T. Waber (Los Alamos Scientific Lab., N. Mex.). Acta Cryst., 18: 104-9(Jan. 10, 1965). (LADC-6270)

Scattering factors for a total of 208 neutral atoms, positive ions, and a few negative ions are given in tabular form and as nine-parameter analytic functions. These scattering factors were computed from relativistic self-consistent field wave functions, which include Slater's approximate exchange correction. (auth)

9901 QUANTUM NUMBERS AND ENERGY LEVELS IN THE THOMAS-FERMI ATOM. A. Kónya (Hungarian Academy of Sciences, Budapest). Acta Phys. Acad. Sci. Hung., 18: 41-53(1964).

Electrons of the Thomas-Fermi atom with equal energy and angular momentum are considered as being in the same quantum states. With the help of the Bohr-Sommerfeld quantization condition these states are characterized by continuously varying quantities, n_r^* and n^*, corresponding to the radial and principal quantum numbers of wave mechanics. States with integral n^* and half-integral n_r^* values correspond to the wave-mechanical one-electron states. As an application of the method developed the energy and the Bohr-Sommerfeld orbits corresponding to the occupied quantum-mechanical states of the Ag atom were determined. The results are in satisfactory agreement with those of wave mechanics. (auth)

9902 VARIATION OF THE INELASTIC COLLISION CROSS SECTION ALONG THE ISOELECTRONIC SEQUENCE OF Si II. M. Blaha (Astronomical Inst., Czechoslovak Academy of Sciences, Ondrejov). Bull. Astron. Inst. Czech., 15: 33-4(1964).

The collision strength for the transition $^2P_{1/2} \rightarrow {}^2P_{3/2}$ of Si II, P III, and S IV ions was determined by the quantum defects method. The results together with the corresponding value for Fe XIV, determined earlier by the DW method, are given. (auth)

9903 EXPERIMENTAL STUDY OF DEUTERIUM BY MEANS OF AN ELECTRON SELECTOR. J.-D. Carette and Larkin Kerwin (Universita de Laval, Quebec). Can. J. Phys., 42: 2022-3(Oct. 1964). (In French)

A recently developed electron selector was used for measurements on deuterium. Forty ionization curves were recorded, using the energy band of electrons extending from the ionization threshold of D_2 to 1 v above the threshold. The first six vibrational levels of D_2^+ were observed. Energies separating the levels and the relative probabilities of formation of the levels are presented. Relative cross sections for formation of D_3^+ by the reaction $D_2^{+*} + D_2 \rightarrow D_3^+ + D$ are given for 4 vibrational levels of D_2. (M.J.T.)

9904 DISPLACEMENT OF ENERGY LEVEL IN A STRONGLY LIGHTED ATOMIC SYSTEM. Georges Lochak (Université, Paris). Compt. Rend., 259: 3183-6(Nov. 9, 1964). (In French)

It is shown that, according to wave mechanics, a light wave of any frequency displaces the energy levels of a quantum system and reduces them. The effect is proportional to the intensity of the incident wave and, if the frequency of wave is in resonance with one of the spectral frequencies of the irradiated system, the displacement of the levels takes an abnormal form as the factor of amplitude in scattering theory. (tr-auth)

9905 CALCULATIONS OF DENSITY OF ELECTRON DISTRIBUTION IN POSITIVELY CHARGED IONS USING STATISTICAL APPROXIMATION AND TAKING INTO ACCOUNT QUANTUM CORRECTIONS. E. A. Bogemskaya (Tomsk State Univ., USSR). Izv. Vysshikh. Uchebn. Zavedenii, Fiz., No. 5, 186-7(1964). (In Russian)

The electron distribution density in positively charged ions was calculated with statistical approximations considering the first quantum corrections. It is shown that at large distances from the ion the distribution density was considerably higher than the density obtained by calculations using the self-consistent field method. (R.V.J.)

9906 ATOMIC AND MOLECULAR EMISSION IN THE NEGATIVE GLOW OF A HELIUM DISCHARGE. W. B. Hurt and W. W. Robertson (Univ. of Texas, Austin). J. Chem. Phys., 42: 556-60(Jan. 15, 1965).

The spatial distribution of helium atomic and molecular radiation was investigated in the negative glow of a d-c discharge. The atomic radiation peaked sharply at the cathode edge of the negative glow, the molecular radiation less sharply at a greater distance from the cathode. Microwave quenching indicated that most of the atomic and all of the molecular radiation results from electron-ion recombination processes. The decrease in atomic radiation reflected the decrease in atomic ion concentration, which was controlled primarily by diffusion away from the cathode and by three-body conversion to molecular ions. The molecular ions were lost by diffusion and by collisional-radiative recombination to the neutral molecule, with collisional processes predominating. The negative glow could be characterized as a plasma steady in time but with a one-dimensional spatial decay away from the cathode. (auth)

9907 PARTIAL WAVE THEORY OF DIATOMIC MOLECULES. [PART] II. A. Temkin and A. K. Bhatia (Goddard Space Flight Center, Greenbelt, Md.). J. Chem. Phys., 42: 644-9(Jan. 15, 1965).

The method of expanding wavefunctions of diatomic molecules in a series of orbital angular momentum eigenfunctions (partial waves) was extended to two-electron homonuclear molecules. Angular momentum was a function of the Euler angles only; a symmetric choice of these angles was used, which greatly facilitates description of the exchange character of the wavefunction. As a result, explicit equations for the three-dimensional "radial" functions can be derived for all the different magnetic, parity, and exchange states. For Σ states the partial wave sums only go over alternate values of the angular momentum giving rise to the expectation of an even more rapidly convergent series in these cases. (auth)

9908 IONIZATION AND EXCITATION OF ARGON WITH ALPHA PARTICLES. G. S. Hurst (Oak Ridge National Lab., Tenn.), T. E. Bortner, and R. E. Glick. J. Chem. Phys., 42: 713-19(Jan. 15, 1965). (ORNL-P-489)

Experimental data on alpha ionization of binary mixtures of gases involving argon suggest that two states of electronic excitation persist long enough after the passage of the charged particle to allow collisions of the type $Ar^* + X \rightarrow Ar + X^+ + e^-$ to occur. One of these states is near the metastable levels in argon, approximately 11.6 ev, and the other is at approximately 14 ev. Examination of electron energy loss data and spectroscopic data led to a tentative identification of these states as resonance levels; thus, their lifetimes are due to the trapping of photons in the apparatus. Ionization yield data were fitted to a kinetic model representing this mechanism with good agreement between the model and the experimental data. Other evidence for the existence of excited states of long lifetimes was derived from light emission experiments with argon in which continuous emission spectra suggested Franck-Condon transitions in excited argon molecules. (auth)

9909 ELECTRON CAPTURE BY PROTONS PASSING THROUGH MOLECULAR HYDROGEN. D. P. Sural (Jadavpur Univ., Calcutta) and N. C. Sil. J. Chem. Phys., 42: 729-32(Jan. 15, 1965).

The cross section for the process $p + H_2 = H + H_2^+$ was calculated from low to moderate energies using the impact-parameter formulation with a two-state approximation. The experimentally measured cross section in this energy range showed a rise and fall with increasing energy of the incident proton. The theoretical calculation reproduced the same behavior with the maximum position slightly shifted toward the lower energy. (auth)

9910 REACTIONS OF 12-135-ev H_2^+ IONS WITH Ar. M. G. Menendez (Univ. of Florida, Gainesville), B. S. Thomas, and T. L. Bailey. J. Chem. Phys., 42: 802-3 (Jan. 15, 1965).

Collision cross sections for the processes $H_2^+ + Ar \rightarrow ArH^+ + H$, $H_2^+ + Ar \rightarrow H^+ + H + Ar$, and $H_2^+ + Ar \rightarrow H_2 + Ar^+$ were measured. Forward-scattered ionic reaction products were identified by an electrostatic retardation analysis. Results are shown on a graph. (M.C.G.)

9911 RELATIVE INTENSITIES OF LYMAN-BIRGE-HOPFIELD BANDS IN ELECTRON IMPACT SPECTRUM OF NITROGEN. Edwin N. Lassettre, Vincent D. Meyer, and Martin S. Longmire (Mellon Inst., Pittsburgh). J. Chem. Phys., 42: 807-9(Jan. 15, 1965).

The transition $X^1\Sigma_g^+ \rightarrow a^1\Pi g$ in N_2 gives rise to the Lyman-Birge-Hopfield bands. These bands are (electric dipole) forbidden. The transition was fully resolved and the relative intensities determined. The spectrum in the energy loss region of 8 to 11 V is shown. (M.C.G.)

9912 ABSORPTION AND PHOTOIONIZATION CROSS SECTIONS OF CO_2, CO, Ar, AND He AT INTENSE SOLAR EMISSION LINES. R. B. Cairns and James A. R. Samson (Geophysics Corp. of America, Bedford, Mass.). J. Geophys. Res., 70: 99-104(Jan. 1, 1965).

Photoionization and total absorption cross sections were measured for CO_2, CO, Ar, and He at the wavelengths from 1040 to 300 Å, which correspond to intense solar emission lines. The wavelength resolution, determined from the measured width of each of the spectral lines generated within the light sources, was in the range 0.04 to 0.1 Å. (auth)

9913 THE FINE STRUCTURE OF THE EXTENDED K ABSORPTION EDGE OF A Ga SINGLE CRYSTAL. E. Alexander, S. Feller, B. S. Fraenkel, and J. Perel (Hebrew Univ., Jerusalem). Nuovo Cimento (10), 35: 311-12(Jan. 1, 1965).

The orientation dependence of the extended fine structure of the K absorption edge of Ga was investigated. The electric vector of the polarized x ray was parallel to the a axis and the c axis of the Ga single crystal. The dependence of the structure was further measured as a function of temperature from the edge up to 130 ev. Runs were taken at room and at liquid air temperatures, and no temperature dependence was observed. (C.E.S.)

9914 INELASTIC COLLISIONS OF SLOW ATOMS. B. M. Smirnov. Opt. Spectry. (USSR) (English Transl.), 17: 273-8(Oct. 1964). Translated from Optika i Spektroskopiya, 17: 504-14(Oct. 1964).

It is shown that for collisions of slowly moving atoms, the adiabatic approximation breaks down when the distances between atoms are small. Such distances between nuclei are easily reached for collisions of light atoms. Then, the cross section of inelastic transition is completely determined by this phenomenon and is expressed by the characteristics of the compound atom. The cross section of the transition consists of two parts. The first part, which prevails in the high-velocity region, decreases sharply with velocity ($\sim v^8$ for the s-s transitions). The second part, connected with the finiteness of the nuclear mass, is a smooth function of the velocity (constant for s-s transitions). The obtained results can be used for studying the ionization of K and L electrons by a heavy charged particle. For a low nuclear charge of the incident particle, they reduce to the Henneberg result. The cross sections were calculated for the inelastic transition and the proton ionization of a H atom, and for the proton charge-exchange of a He atom. (auth)

9915 THE AUTOIONIZATION OF He ATOMS, Li ATOMS, AND Be$^+$ IONS. R. Kh. Propin. Opt. Spectry. (USSR) (English Transl.), 17: 332-3(Oct. 1964). Translated from Optika i Spektroskopiya, 17: 618-20(Oct. 1964).

It is noted that the probability of autoionization of Li and Be was previously calculated, however the use of the wave functions for the autoionized states was approximate in these calculations. A recalculation of these functions is described and used in determining autoionizing states in He and Li atoms, and Be$^+$ ions. (J.R.D.)

9916 HIGH ENERGY α SATELLITES IN THE ALUMINIUM K X-RAY EMISSION SPECTRUM. W. L. Baun and D. W. Fischer (Air Force Materials Lab., Wright Patterson AFB, Ohio). Phys. Letters, 13: 36-7(Nov. 1, 1964).

Experimental results from the determination of wavelength and intensity of diagram and satellite lines in the aluminum K spectrum are discussed. The results, including intensities, extrapolated excitation potentials, and line shifts, support the generally accepted theory of multiple ionization as the source of high energy K_α satellites in the aluminum K spectrum. (C.E.S.)

9917 THREE-BODY BOUND STATE IN XENON. E. Buluggiu and C. Foglia (Università, Parma, Italy). Phys. Letters, 14: 26-7(Jan. 1, 1965).

It is shown that for Xe there exists triatomic molecules, and the upper limit for their binding energy was calculated. (C.E.S.)

9918 ON A SIMPLE METHOD OF CALCULATING ATOMIC ONE-ELECTRON EIGENFUNCTIONS. P. Gombás (Univ. of Technical Sciences, Budapest). Phys. Letters, 14: 30-1(Jan. 1, 1965).

A method to obtain atomic one-electron eigenfunctions is developed by means of a procedure, which is intimately connected with a statistical atom model, in which electrons are grouped in shells according to the principal quantum number. Apart from the outermost electrons of the atom the obtained eigenfunctions approximate very well the Hartree functions. (C.E.S.)

9919 LOW-FIELD RELAXATION AND THE STUDY OF ULTRASLOW ATOMIC MOTIONS BY MAGNETIC RESONANCE. Charles P. Slichter and David Ailion (Univ. of Illinois, Urbana). Phys. Rev., 135: A1099-110(Aug. 17, 1964). (COO-1198-225; TID-20545)

Conventional resonance can be used to study motion of atoms by measurement of linewidth when the mean time τ between jumps is less than $1/\Delta\omega$, where $\Delta\omega$ is the rigid lattice linewidth, or by measurement of the spin-lattice relaxation time, T_1, when $\tau \sim 1/\omega_0$, where ω_0 is the Larmor frequency. A new technique applicable when $\tau < T_1$ is described. It is therefore applicable to the study of very slow motion. The method is analogous to measuring T_1 with $\omega_0 = 0$. However, ω_0 can be kept in the megacycle region by performing the experiments in the reference frame rotating at the Larmor frequency. Analysis of the technique requires solution of the problem of the effect of infrequent motion on the nuclear relaxation time when the applied static field is comparable to the local field. The relaxation time is then comparable to τ, indicating that jumps are strong "collisions" for the spins. The case of strong "collisions" is not treated in the conventional treatment of Bloembergen, Purcell, and Pound. The problem is solved by use of the concept of spin temperature and the sudden approximation. Explicit formulas are given for the nuclear relaxation in the laboratory for weak static fields, and in the rotating frame for alternating fields of the order of or less than the local field. Both diffusional motion and molecular reorientation are treated. (auth)

9920 SELECTION OF W Kα_1 AS THE X-RAY WAVELENGTH STANDARD. J. A. Bearden (Johns Hopkins Univ., Baltimore). Phys. Rev., 137: B455-61(Jan. 25, 1965).

Precision measurements showed that the x-unit scale of x-ray wavelengths based on Mo Kα_1 = 707.831 xu is about 20 ppm smaller than that in general use for Cu Kα_1 and longer wavelengths, and for substantially all crystal parameters. Furthermore, the conversion from the Cu Kα_1 = 1.537400 kxu to Å was increased from 1.00202 to 1.002056 ± 5 ppm. New techniques permit wavelength measurements to be made with relative probable errors of ±1 ppm. New wavelength and crystal-parameter tables are now necessary. Thus the opportunity arises for introducing an x-ray wavelength standard. To select the best wavelength for the standard, the following studies were carried out: relative measurements of five wavelengths with five crystals, employing a least-squares adjustment; γ-ray study of single-crystal diffraction patterns and the use of a γ-ray wavelength as a standard; crystal imperfections and their effect on wavelength measurements; effect of chemical impurities on grating constants; and redetermination of the absolute wavelength scale. The requirements of a standard are analyzed and the advantages of the W Kα_1 line listed. Its wavelength is 0.209010 Å ± 5 ppm on the absolute scale, and without error as the designated standard. With this standard, new wavelength tables were prepared, which include a large number of new measurements of secondary wavelength standards used as reference lines in many original measurements. Probable errors on both the relative and the absolute scale were included. (auth)

9921 CROSS SECTIONS FOR CHARGE-EXCHANGE REACTIONS OF THE TYPE $H^+ + H(n_1l_1m_1) \rightarrow H(n_2l_2m_2) + H^+$. Robert M. May and J. G. Lodge (Univ. of Sydney). Phys. Rev., 137: A699-702(Feb. 1, 1965).

Charge-exchange reactions of the general type $H^+ + H(n_1l_1m_1) \rightarrow H(n_2l_2m_2) + H^+$ are considered, and some recently derived sum rules are used to get comparatively simple closed expressions for the cross section. Calculations are performed in the Born approximation. All excited target H atoms with $n_1 \geq 2$ and all (appropriate) $l_1 \geq 1$ are considered, and an average over m_1 is performed. The total cross section for formation of final states with given principal quantum number n_2 is evaluated. These results may be easily modified to include the case where the target atoms are H-like alkali atoms. (auth)

9922 QUANTUM CORRECTIONS IN THE THOMAS-FERMI MODEL. Harry M. Schey and Judah L. Schwartz (Univ. of California, Livermore). Phys. Rev., 137: A709-16(Feb. 1, 1965).

Quantum corrections to the Thomas-Fermi model of the atom derived by expansion procedures are examined numerically. Corrected potentials, one-electron eigenvalues and eigenfunctions, dipole oscillator strengths, diamagnetic susceptibilities, and electron binding as a function of atomic number are considered. In all cases the corrected quantities either agree less well with experiment than the results of the simple zeroth-order theory or show improvement which is inconsistent, unimpressive, and unreliable. These results lend strong support to conjectures made by others that the expansion methods leading to the quantum corrections give rise to series which are asymptotic and which fail to include important oscillatory terms. (auth)

9923 ANALYTIC EXPRESSIONS FOR THE BORN APPROXIMATION TO CERTAIN ELEMENTS OF THE REACTANCE MATRIX IN e^--H SCATTERING. Bruce L. Scott (Univ. of Southern California, Los Angeles and TRW Space Tech. Labs., Redondo Beach, Calif.). Phys. Rev., 137: A717-20(Feb. 1, 1965).

Analytic expressions are presented for the elements of the reactance matrix connecting the ground state (1s) and the degenerate first excited states (2s, 2p) of the hydrogen atom in the Born approximation to e^--H scattering. The results can be expressed entirely as algebraic functions of Legendre functions of the second kind and their first, second, and third derivatives. A discussion of computational methods which illustrates the usefulness of these expressions is also given. (auth)

9924 INTRINSIC PHOTOEMISSION OF ALKALI HALIDES. Steven W. Duckett and P. H. Metzger (Aerospace Corp., El Segundo, Calif.). Phys. Rev., 137: A953-9 (Feb. 1, 1965).

The photoemission from evaporated films of 12 alkali halides was measured in the 10- to 21-ev energy region. In addition, some preliminary optical-density values were obtained by measuring the transmission of evaporated layers of these compounds deposited on 450 Å-thick, self-supporting, Al_2O_3 films. The photoemission yield curves show broad structures correlated with the absorption coefficients. In general, the photoemission is a maximum for photons of energies of about 5 ev greater than the forbidden-gap energy E_g, with additional peaks beyond 2 E_g. The correlation of the yield with the absorption coefficient is most pronounced in the alkali fluorides, which have relatively low yields, but is less apparent in the other halides, which have peak values of as much as 0.8 electron/photon. A random-walk model of electron scattering is used to estimate the magnitude of the yields and the dependence on the absorption coefficient, with good qualitative agreement with the experimental results, but other processes cannot be ruled out. (auth)

9925 MEASUREMENT OF TOTAL ATTENUATION CROSS SECTIONS IN ALUMINUM AND GOLD FOR 14.4-kev GAMMA RAYS. J. Alonso and L. Grodzins (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 137: A975-8 (Feb. 1, 1965). (MIT-2098-66)

Total attenuation coefficients of aluminum and gold for 14.4-kev gamma rays were measured using a resonant (i.e., Mössbauer) detector to reduce forward scattering and background corrections. The results are 390.7 ± 0.7 and 59,290 ± 70 barns per atom for aluminum and gold, respectively. These values imply photoelectric cross sections of 371.0 ± 0.7 and 58,220 ± 70 barns/atom, respectively. The results are in agreement with other, less precise, measurements in this energy region. Theoretical estimates of these cross sections are high by 5% for aluminum and 35% for gold. (auth)

9926 ELECTRIC DIPOLE MOMENT OF THE CESIUM ATOM. A NEW UPPER LIMIT TO THE ELECTRIC DIPOLE MOMENT OF THE FREE ELECTRON. P. G. H. Sandars and E. Lipworth (Brandeis Univ., Waltham, Mass.). Phys. Rev. Letters, 13: 718-20(Dec. 14, 1964).

An atomic-beam method is used to measure the electric dipole moment of the Cs atom. The atomic beam passes between two closely spaced metal plates, which lie between the loops of a double-hairpin structure. A Zeeman transition is induced, and variations in the Zeeman resonance are amplified. The Cs atomic electric dipole moment is measured by this method as 2.2×10^{-19} cm$\cdot \underline{e}$. The electric dipole moment of the free electron is calculated from the atomic result to be 2×10^{-21} cm$\cdot \underline{e}$. The implications of these results as regards the validity of time-reversal invariance are discussed. (T.F.H.)

9927 ATOMIC MASSES OF H^1, Cl^{35}, AND Cl^{37}. Jay L. Benson and Walter H. Johnson, Jr. (Univ. of Minnesota, Minneapolis). Phys. Rev. Letters, 13: 724-6(Dec. 14, 1964).

Results are presented of measurements of mass doublets, which allow the calculation of the masses of ^1H, ^{35}Cl, and ^{37}Cl. The measurements are made with a 16-in. mass spectrometer, using a peak-matching technique in which the peak shapes of the ion groups comprising the doublet are stored in a digital-memory oscilloscope. An error signal proportional to the doublet mismatch grows in the oscilloscope memory. The error signal is then used to calculate the mass difference with high precision. (T.F.H.)

9928 A TABLE OF ATOMIC MASSES BASED ON THE MASS OF THE CARBON-12 NUCLIDE. M. Isabel Jeronimo (Faculdade de Ciencias, Lisbon). Rev. Port. Quim. (Lisbon), 5: 218-21(1963). (In Portuguese)

Utilization of a table of atomic masses based on the mass of ^{12}C to unify the chemical and physical scales is discussed, and advantages of the use of ^{12}C over ^{16}O are given. The conversion factors to be used in going from the physical scale to the unified scale and from the chemical scale to the unified scale were calculated. The atomic masses of the ^{12}C scale were tabulated. (J.S.R.)

9929 ELIMINATION OF THE COMPTON COMPONENT IN AMORPHOUS SCATTERING. B. E. Warren and G. Mavel (Massachusetts Inst. of Tech., Cambridge). Rev. Sci. Instr., 36: 196-7(Feb. 1965).

Experimental elimination of the Compton component in amorphous scattering was obtained by using crystal monochromated Rh Kα radiation (λ = 0.615Å). The scattered radiation from the sample falls upon a sheet of Mo (λK edge = 0.620Å). The fluorescence radiation, which is received in a Kr filled counter placed near the Mo, is closely a measure of the unmodified scattering since most of the modified scattering cannot excite fluorescence. The counter reading is high enough for direct chart recording. (auth)

9930 THEORETICAL STUDY OF THE FREQUENCY STABILITY OF A MOLECULAR GENERATOR. A. N. Oraevskii (Lebedev Inst. of Physics, Moscow). Tr. Fiz. Inst., Akad. Nauk SSSR, 21: 3-67(1963). (In Russian)

Equations are derived for the frequency stability of molecular generators from the viewpoint of their use as frequency standards. The oscillation frequency is calculated as a function of various parameters and shown to agree well with experimental data, thus confirming assumptions made in the calculations. These calculations predict a frequency stability of 5 to 7×10^{-10} for the line J = 3, K = 3 of $^{14}NH_3$ and predict that for higher stability a line without quadrupole fine structure should be used. The tuning of the oscillation frequency of molecular generators is considered theoretically. By the use of slow molecule beams it might be possible to attain a stability of 10^{-11}. Experimental observations confirmed the possibility of tuning generators to the frequency of a spectral line with a precision of 1.5 to 1×10^{-10}. 68 references. (TTT)

9931 THE INVESTIGATION OF THE CHARACTERISTICS OF MOLECULAR GENERATORS. (THE $^{14}NH_3$ LINE J = 3, K = 3). G. M. Strachovskii and I. V. Cheremickin (Lebedev Inst. of Physics, Moscow). Tr. Fiz. Inst. Akad. Nauk SSSR, 21: 69-106(1963). (In Russian)

A study was made of the dependence of the frequency and the relative energy magnitude of the $^{14}NH_3$ line for J = 3, K = 3 on the characteristic resonator frequency, the charge on the quadrupole condenser (or on the circular resolving system), and the ammonia pressure in the molecular-beam source. Also, the frequency and relative energy dependence was investigated for a molecular generator with two colliding beams. The results obtained conform to the theory given in previous work. A relative stability of 10^{-11} was attained over a period of four hours. Methods of tuning the molecular generator with a reproducibility of 5×10^{-10} are described. The width of the spectral line was measured for different types of sources of the molecular beam, and it was found that the canal type of source was best suited for prolonged use. 74 references. (TTT)

9932 THE THEORY OF THE FINE STRUCTURE OF THE ROTATIONAL SPECTRA OF MOLECULES. K. K. Svidzinskii (Lebedev Inst. of Physics, Moscow). Tr. Fiz. Inst., Akad. Nauk SSSR, 21: 107-75(1963). (In Russian)

The theory of the fine structure of molecular rotational spectra is treated mathematically. By the use of group theory and especially of irreducible tensor operators and 3 nj-symbols, it was found possible to simplify the calculation of weak interactions. The effectiveness of this method is shown by calculation of the relatively simple case of the inversion spectra of ND_3. To assure the required precision, not only dipole and quadrupole interactions are included, but also octupolar magnetic and hexadecapolar electric interactions. The inclusion of the spin-moment interaction is also a means of increasing the precision. Calculation of the fine structure of the NH_3 inversion spectrum permits a satisfactory interpretation of the experimental observations of the spectrum of the transition $J = K = 6$. On the basis of this calculation, the absolute frequency stability is 2.5×10^{-10} for the molecular generator with a molecular beam of ND_3. 35 references. (TTT)

9933 A MOLECULAR GENERATOR WITH A MOLECULAR BEAM OF ND_3. N. G. Basov, V. S. Zuev, and K. K. Svidzinskii (Lebedev Inst. of Physics, Moscow). Tr. Fiz. Inst., Akad. Nauk SSSR, 21: 176-99(1963). (In Russian)

The construction of the molecular generator is described in detail, including the molecular beam source, the selector system, the resonator, the vacuum system, and the hook-up of the system for detecting the emitted radiation. A series of lines for inversion transitions of ND_3 were measured together with their intensities. The absolute frequency stability of a generator using the transition $J = K = 6$ was of the order of 10^{-9}. Stability could be improved by substitution of $^{15}ND_3$ for the $^{14}ND_3$ because of the absence of quadrupole fine structure in the former. The small power of such a generator is not an impediment to its use as a frequency standard since the sensitivity of detectors in the region of 18 cm is considerably greater than for the region of 1.25 cm (NH_3). Thus it was found possible to obtain a signal to noise ratio exceeding 100 to 1. (TTT)

9934 THE QUESTION OF THE NEUMAN-WIGNER THEOREM. B. M. Smirnov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 38-46(May-June 1964). (In Russian)

An analysis was made of the Neuman-Wigner theorem. The theorem holds that the energy levels of states of identical symmetry do not intersect at any value of the parameter. The validity of this theorem was contradicted by S. S. Gershtein et al (Zh Exp. i Teorit. Fiz. 40, 1491, 1961) in which it was asserted that the terms of identical symmetry of an electron in the field with two Coulomb centers do intersect. An attempt was made to show also that the theorem does not hold in the case of separation of variables in the Schroedinger equation. General conclusions were made regarding the impossibility of two terms of different symmetry coinciding. In particular it is demonstrated that the ground-state energy level cannot intersect with the other levels. (R.V.J.)

9935 DECAY OF Tb^{160}—STUDY OF EXCITED LEVELS OF STRONGLY DEFORMED NUCLEI IN RARE EARTH REGION. PART III. Pai-kwun Ong, Kuo-kwang Yian, Shan-ken Chu, Shih-ping Chen, Shian Ho, Shu-fang Wang, and Lin-sheng Cheng. Wu Li Hsueh Pao, 19: 524-36(1963).

Using double-lens β spectrometer, double-focusing iron yoke β spectrometer, scintillation spectrometer, and coincidence techniques, the decay of ^{160}Tb (with half life of 72 days) was studied. Five groups of β spectra were observed with end-point energies, relative intensities, and log ft values: 274 kev (9%) 7.9, 464 (14%) 8.5, 562 (42%) 8.1, 868 (34%) 8.9, and 1740 (0.4%) 11.9 respectively. The energies of twenty seven γ rays were determined by means of internal conversion lines, external conversion lines, and scintillation spectra. Nine of the twenty seven γ rays were observed for the first time. An ion-exchange technique was used to confirm the existence of high energy γ rays (above 1410 kev) in the decay of ^{160}Tb. According to the γ-γ coincidence measurements and Ritz's rule between the energies of the observed γ rays, fourteen excited levels of ^{160}Dy were established, the energies, spins and parities of which are $86.6(2^+)$, $283.5(4^+)$, $965.7(2^+)$, $1048(3^+)$, $1198(1^-)$, $1264(2^-)$, $1287(3^-)$, $1358(3^-)$, $1398(3^-)$, 1566, 1591, 1658, 1696, and 1721 kev, respectively. Finally, a decay scheme is proposed and the level structure of ^{160}Dy is discussed in the light of the Bohr-Mottelson unified model. (Sci. Abstr. China, Math. Phys. Sci., 2: No. 2, 1964)

9936 INFLUENCE OF DISTORTION AND NOISE FOR MEASUREMENT OF THE MULTIPLE COULOMB SCATTERING IN THE EMULSION AND ITS ELIMINATION. Jing-ry Ren. Wu Li Hsueh Pao, 20: 81-90(1964).

The influences of distortion of emulsion on multiple Coulomb scattering are discussed and an objective criterion for closing cell-length for measurements under different circumstances is given. The method of small cell-length (method of center of gravity), which is known to have the advantage of suppressing the influence of noise, was extended to apply to measure high energy ($P\beta C \sim$ several Bev) particles and is shown to give good results, thus, providing a better method for measuring high energy particles. Further, method of small cell-length and method of higher-order differences were combined into a single method, which gives results in agreement with those obtained by conventional method. The new method has the advantages of eliminating the influences of distortion more effectively and it can be applied to tracks with larger dipping angles. Thus, it provides a good possibility of extending the range of measurements to rather dipped tracks. (Sci. Abstr. China, Math. Phys. Sci., 2: No. 2, 1964)

9937 CHEMICAL SPUTTERING OF REFRACTORY METALS AT ELEVATED TEMPERATURES. Dean Roy Denison. Thesis, Pullman, Wash., Washington State Univ., 1963. 65p.

Positive ions emitted from heated tungsten filaments operating in various gas environments and in residual gases remaining at 10^{-11} torr were investigated. The ions appear both as a continuous current and in the form of ion bursts. The pressure and temperature dependence of the ion current is given; the properties of the bursts are investigated; and a model for the mechanism of burst production is proposed. It is shown that the ion current can be used as a sensitive indicator of surface reactions. It is further shown that anomalous behavior in the Bayard-Alpert ionization gage operating at low grid currents at low pressure can be attributed to the emission of impurities from the filament. (Dissertation Abstr., 25: No. 3, Sept. 1964)

9938 DOUBLE EXCITATION OF HELIUM BY ELECTRONIC IMPACT. Philip Monroe Becker. Thesis, Minneapolis, Univ. of Minnesota, 1964. 65p.

The theory and calculation of cross sections for the electron impact excitation of anomalous states in helium were studied. The anomalous states are those for which both atomic electrons occupy excited orbitals. Calculations were performed only for anomalous states stable to autoionization. The cross sections exhibit sharp peaks just above the threshold energy for excitation and decrease rapidly with further increase of energy. The maximum value of the Born-Oppenheimer cross section for excitation of the $(2p)^2\ {}^3P_g$ state is about $6 \times 10^{-4}(a_0)^2$ and occurs about 11 ev above threshold. The cross sections for excitation of the $2p3p\ {}^1P_g$, $2p3d\ {}^3D_u$, and $2p3d\ {}^1D_u$ states are all less than 35 barns. The cross section for the $(2p)^2\ {}^3P_g$ state was calculated according to the Born-Oppenheimer, distorted wave, and two-state strong coupling approximations. In all of these cases the maximum amplitude of the scattering beam occurs at right angles to the direction of the incident electrons. The cross sections of the potential and exchange distortion methods and of the complete two-state strong coupling approximations are virtually identical. The Born-Oppenheimer approximation provides remarkably similar results. Rigorous upper bounds to the energies of the $2p3p\ {}^1P_g$, $2p3d\ {}^3D_u$, and $2p3d\ {}^1D_u$ states of helium are reported. A survey is included of the information presently available on doubly-excited states. (Dissertation Abstr., 25: No. 3, Sept. 1964)

9939 CHARGE-CHANGING COLLISIONS OF OXYGEN IONS IN THE 50-400 KILOVOLT KINETIC ENERGY RANGE. Wayne Wilson Lang. Thesis, Lincoln Neb., Univ. of Nebraska, 1964. 97p.

Beams of O^+ and O^{2+} ions were accelerated to kinetic energies in the range 50-400 kev, brought into charge equilibrium in gases H_2, He, and O_2, and the fractional amounts of O^-, O^0, O^+, O^{2+}, and O^{3+} were measured. Positive ions of higher charge values were present in the equilibrated beams, and upper limits were placed on these fractions. By holding each separated charged constituent successively in an orbit in a magnetic field, admitting gas, and observing the beam attenuation, the total cross section for all charge-changing collisions was observed. Through application of the differential equations for growth or decay of a charged component, certain individual charge-changing cross sections can be deduced from these observed sums. Single electron capture and loss cross sections were deducted from the experimental results by making certain estimates on the rather small cross sections for double electron losses and captures. These deduced cross sections were compared with data from other experiments. Good agreement is reported between the data at the high energy limit of this experiment and that of Dmitriev and Nikoleav. The maxima of the electron loss cross section curves fit well the values predicted by theory. (Dissertation Abstr., 25: No. 3, Sept. 1964)

9940 WAVE FUNCTIONS FOR ONE AND TWO ATOM SYSTEMS. James Elmer Swain. Thesis, Manhattan, Kan., Kansas State Univ., 1964. 103p.

The general Schrödinger's equation is rewritten in integral equation form using a Green's function technique. The integral equation is solved by expanding the wave function into a series, continuous and discrete, of appropriate functions. This general procedure is then reapplied to the case of atomic, molecular, and collision wave functions for systems with one or two nuclei and many electrons. In the case of atomic wave functions the theory is developed in detail for the electrostatic helium atom and the relativistic, to terms of order v^2/c^2, hydrogen atom. The theory of the collision of two hydrogen atoms and of the hydrogen molecule is developed in detail. The numerical calculations for the electrostatic helium atom were carried out on a computer. A set of wave function constants, the interaction energy matrix elements, were evaluated analytically, programmed, and tabulated numerically. The energy of the helium atom along with the wave function expansion coefficients were evaluated for the first 25 states of helium. The ground state energy was found to be 1.8% larger than the experimental value. The energy of the 2^1S, 2^3S, 2^1P, and 2^3P were found to be 8.7%, 2.8%, 6.7%, and 3.8%, respectively, larger than the corresponding experimental values. The calculated energy of the only observed state of multiple excitation, (the $2p^{23}P$ state), was found to be 28% larger than the experimental value. The main reason for these discrepancies is the truncation of a double sum in the exact theory of the electrostatic helium atom in order that the computations could be carried out on an available computer. (Dissertation Abstr., 25: No. 3, Sept. 1964)

9941 ELECTRON INDUCED SURFACE IONIZATION MASS SPECTROMETRY. David Lichtman (Honeywell Research Center, Hopkins, Minn.). 8p. (CONF-649-10)

From 12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964.

An ultrahigh vacuum mass spectrometer is used to study beam-surface interactions and ion desorption from surfaces under electron bombardment. A typical background spectrum is analyzed, and the surface phase spectra obtained from electron bombardment of stainless steel and nickel targets are presented. (H.D.R.)

9942 CROSS SECTION MEASUREMENTS AND TRANSPORT PROPERTIES IN SEEDED INERT GAS MPD GENERATORS. A. B. Jolly and J. Newcombe (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). 11p. (CONF-640701-68)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Experimental values are presented and used as the basis of a study concerning the effects of resolution on the interaction cross sections for Cs, Na, and K with He, Ne, and Ar. Results indicate that an appreciable interaction force exists between colliding atoms, and the increase in scattering cross section is greater than for hard spheres. (J.R.D.)

9943 IONIZATION OF POLYATOMIC MOLECULES IN COLLISIONS WITH EXCITED METASTABLE NOBLE GAS ATOMS. V. Čermák and Z. Herman (Inst. of Physical Chemistry, Czechoslovak Academy of Science, Prague). 6p. (CONF-649-25)

From 12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964.

Ionization and fragmentation of lower hydrocarbons, methanol and ethanol, in collisions with excited metastable helium, neon, and argon atoms were studied by means of mass spectrometric techniques. Ion abundances and distribution energies were measured and compared with theoretical predictions. (H.D.R.)

Cosmic Radiation

Refer also to abstract 9874.

9944 (AD-443485) COSMIC RADIATION: AN ANNOTATED BIBLIOGRAPHY. Peter R. Stromer and Helen B. McCormick, comps. (Lockheed Missiles & Space Co., Sunnyvale, Calif.). May 1963. Contract AF04(647)-787. 70p. (SB-63-71). OTS.

This comprehensive bibliography emphasizes the near-Earth space environment as differentiated from interplanetary space. Period of coverage is from 1960 to early 1963. A detailed subject index has been provided. 162 references. (auth)

9945 (AFCRL-64-487) MEASUREMENT OF THE COSMIC RAY NEUTRON FLUX AT 45° GEOMAGNETIC LATITUDE. G. Boella, G. Degli Antoni, C. Dilworth, M. Panetti, L. Scarsi (Milan. Universita. Istituto di Scienza Fisica; Italy. Istituto Nazionale di Fisica Nucleare, Milan); and D. Shapiro (Air Force Cambridge Research Center, Bedford, Mass.). May 11, 1964. 40p. (AD-602653). $2.00(OTS).

In a series of balloon flights with a light-weight neutron detector, the flux of the cosmic ray neutrons in the atmosphere at 45 degrees geomagnetic latitude was investigated. Values of the neutron flux through the atmosphere are given and, by extrapolation to zero pressure, the neutron leakage was determined as (0.45 ± 0.07) neutron/sq. cm/sec. at the top of the atmosphere. A detailed study of experiments on albedo neutrons which led to conflicting results was made. It was shown that the apparent discrepancies can be accounted for by instrumental bias and locally produced neutrons. (auth)

9946 (ASE-546) A RESEARCH PROGRAM TO INVESTIGATE THE CHARGED PARTICLE FLUX IN THE NEAR-EARTH MAGNETOSPHERE FROM A P-11 SUB-SATELLITE. Final Report. F. R. Paolini, R. Giacconi, J. R. Waters, and T. G. Quinn, Jr. (American Science and Engineering, Inc., Cambridge, Mass.). May 27, 1964. Contract AF19(628)-2392. 355p. (AFCRL-64-435; AD-603790). $7.00(OTS).

Three instrument packages were designed, developed, constructed, tested, and calibrated for the purpose of investigating energy spectra and angular distributions of protons and electrons in the Earth's magnetosphere from a P-11 sub-satellite. The principles of operation, complete circuit diagrams, testing and calibration procedures, and calibration curves pertaining to the instruments are presented. Pertinent payload integration information is given. Methods of data handling, reduction, and analysis, including those aspects dependent upon computer utilization, are outlined. One of the instrument packages was flown on Air Force Satellite 1963-25B. Some preliminary results on energy spectra obtained from early orbits are given. Geiger counter and electron spectrometer rate of energy deposition data illustrated belt profiles as expected, with distinct inner and outer zones with a well defined slot between them. (auth)

9947 EVIDENCE FOR GALACTIC ORIGIN OF OBSERVED ANISOTROPY OF COSMIC RADIATION AT THE EARTH. S. Standil and R. P. Bukata (Univ. of Manitoba, Winnipeg, Can.). Can. J. Phys., 42: 1834-5(Sept. 1964).

Two muon telescopes at right angles to each other were used to detect secondaries produced by primary cosmic radiation of energy greater than about 40 Bev. Data are presented of counts vs viewing direction for January through July, 1964. The variation of observation date with viewing angle for peak number of counts indicates a primary cosmic radiation source of galactic origin. (M.J.T.)

9948 THE CHANGE IN HIGH-ENERGY NUCLEONS WITH ALTITUDE IN THE ATMOSPHERE. Kh. P. Babayan, N. L. Grigorov, E. A. Mamidzhanyan, and V. Ya. Shestoperov. Dokl. Akad. Nauk Arm. SSR, 38: 101-4(1964). (In Russian)

Six series of ionization chambers (each 330 cm long and 10 cm in diameter) were used for measuring absorption of nuclear-active particles in young atmospheric showers at altitudes of 200 to 3250 m. Calculations indicated that absorption tracks of nuclear-active components in the atmosphere are determined only by nucleon absorption, although the number of mesons ($\pi^{\pm}$) among $\geq 10^{12}$ ev particles in the atmosphere may reach 40% of the number of nucleons. Two hundred and seventy-nine showers were recorded at 3250 m and 37 at 200 m. During the transition from sea level to 3200 m the shower intensity increased 14 to 16 times. The young showers were generated by one interaction event over the installation. The results showed that the virtual number of young atmospheric showers at sea level is $\geq 1.7 \times 10^{12}$. Absorption tracks of 2×10^{12}-ev nucleons at lower atmosphere elevation were 109 ± 8 g/cm^2. (R.V.J.)

9949 TRANSPORT COLLISION INTEGRALS FOR QUANTUM GASES OBEYING A 12-6 POTENTIAL. R. J. Munn (Univ. of Maryland), Francis J. Smith, E. A. Mason, and L. Monchick. J. Chem. Phys., 42: 537-9(Jan. 15, 1965). (IMP-AEC-32)

The transport collision integrals for the 12-6 potential were calculated with exact quantal phase shifts. Tables of the collision integrals, accurate to 1 or 2 parts in 1000 over most of the temperature range, were prepared for reduced temperatures kT/ϵ from 0.01 to 100 and for a number of values of the reduced de Broglie wavelength up to a value of 3.5 in steps of 0.5. The effects of statistics are included. (auth)

9950 SOME RESULTS OF RADIOMETRIC MEASUREMENTS AT 200 TO 400 KM ELEVATION DURING 1960 TO 1963. S. N. Vernov, I. A. Savenko, P. I. Shavrin, V. E. Nesterov, N. F. Pisarenko, M. V. Tel'tsov, T. I. Pervaya, and V. N. Erofeeva. Kosmich. Issled., 2: 136-46 (Jan.-Feb. 1964). (In Russian)

Radiation intensities recorded by 15 satellites and rockets at 175 to 405 km during August 1960 through May 1963 were analyzed. Daily doses for various flight trajectories and mean daily intensities at various radiation belt points were measured. Intensity variations related to the 11-year solar cycle indicated a genetic tie between the saturation and initial cosmic rays. The lifetimes of particles in a belt with mirror points at 300 to 400 km were estimated. (tr-auth)

9951 MEASUREMENTS OF THE TOTAL RADIATION DOSE IN VOSTOK-5 AND VOSTOK-6. I. A. Savenko, N. F. Pisarenko, P. I. Shavrin, and V. E. Nesterov. Kosmich. Issled., 2: 147-9(Jan.-Feb. 1964). (In Russian)

Data are given on the total radiation dose recorded in Vostok-5 and -6 during the flights of June 14-16, 1963. (tr-auth)

9952 MEASUREMENTS OF SOFT RADIATION IN THE PRE-EQUATORIAL LATITUDE BY KOSMOS-4. I. A. Savenko, P. I. Shavrin, N. F. Pisarenko, V. E. Nesterov, M. V. Tel'tsov, and V. N. Erofeeva. Kosmich. Issled., 2: 150-3(Jan.-Feb. 1964). (In Russian)

A soft corpuscular radiation in the pre-equatorial region was recorded by a scintillation counter in Kosmos-4. The obtained data indicate the presence of electrons with energies exceeding 3×10^4 ev. The recorded fluxes varied from 10^2 to 10^5 particles $\cdot$ cm^{-2} $\cdot$ sec. (tr-auth)

9953 PROPAGATION OF HIGH ENERGY NUCLEONS THROUGH ATMOSPHERE AND MESON PRODUCTION. L. T. Baradzei, V. I. Rubtsov, Yu. A. Smorodin, and M. V. Soloev (Lebedev Inst. of Physics, Moscow and Moscow State Univ.). Nukleonika, 9: 277-90(1964). (In Russian)

Data on the penetration of nucleons at 10^{11} to 10^{14} ev through various depths of atmosphere and on meson production were analyzed. The energy of electron-proton showers produced by local nuclear reactions in a graphite slab and the energy spectra of an incidence cascade produced in the atmosphere by γ quanta from meson (π) decay were measured from an airplane. The measurements showed that the main portion of mesons (π^0) was accompanied by showers with energies exceeding meson (π^0) energy by an order of 1 to 10. The 20 to 30% of the total number of events with shower energy higher than meson (π^0) energy was produced by primary $A \approx 10$ nuclear interactions. Data are given on the primary nucleon spectra and absorption spectra of nuclear-active components at energies from 5×10^{11} to 10^{14}. In addition to fire ball type mechanisms of meson (π) production at energies below 10^{14} ev, another mechanism was found, producing mesons (π) with energies proportional to the initial energies. Calculations of charged meson (π) flux indicated a considerable contribution of mesons (π) to the nuclear-active components at 10^{11} to 2×10^{12} ev. Nearly half of the nuclear cascades at 10^{11} to 2×10^{12} ev produced in thin filters were formed by mesons (π^+). It is also shown that the largest portion of mesons (μ) in the atmosphere at sea level was produced by meson (π) decay. (R.V.J.)

9954 INVESTIGATION OF "YOUNG" E.A.S. AT THE ALTITUDE OF 3260 m a.s.l. Kh. P. Babayan, N. L. Grigorov, E. A. Momidzhanyan, V. Ya. Shestoperov, and Ch. A. Tretyakova (Moscow State Univ.). Nukleonika, 9: 299-306(1964). (In Russian)

Studies of young atmospheric showers showed that the observed spectrum shape, the absolute intensity of the young showers, the ratio of electron-photon energy, and the nuclear-active components contradicted the assumption that young showers are formed by interactions typical to pion production processes (large pion production multiplicity with energy transfer from π^0 mesons to $K_{\pi^0} = 0.1$ to 0.2). However, the interactions leading to formation of young atmospheric showers differed greatly from mean interactions (ordinarily their total inelasticity coefficient is $K \geq 0.8$), the part of the energy transmitted by π^0 meson to $K_{\pi^0} \geq 0.67 \pm 0.06$, and the effective π^0-meson production multiplicity is 2 to 4 for 2×10^{12} to 2×10^{13} ev showers. The interactions with nearly complete inelasticity ($K \geq 0.8$) and 70% energy transmission from the primary particle to π^0 meson occurred with an order of probability of $0.1 \leq W < 0.25\%$. Basically, young atmospheric showers do not generate at the expense of hyperon decay or known isobars of π^0 mesons and nucleons. (R.V.J.)

9955 ATTENUATION COEFFICIENTS OF THE COSMIC-RAY NUCLEONIC COMPONENT IN THE LOWER ATMOSPHERE. F. Bachelet, P. Balata, E. Dyring, and N. Iucci (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). Nuovo Cimento (10), 35: 23-35(Jan. 1, 1965).

Attenuation coefficients of the nucleonic component of cosmic rays in the lower atmosphere are obtained both by measurements with a mobile monitor in summer 1963 and by statistical regression analysis on 1962 and 1963 data of 25 IGY neutron stations; the advantages of using the successive differencing method in this regression analysis are studied. The latitude dependence of the coefficient is clearly established at least for the stations at sea level (more than 10% difference between pole and equator values). An altitude dependence of the attenuation coefficient opposite to the one existing in the upper atmosphere is found in the lower atmosphere; here the coefficient decreases with increasing atmospheric depth, showing a hardening of the nucleonic component which is tentatively attributed to the increasing contribution of muons to the star-producing radiation in the IGY neutron monitors. (auth)

9956 SOME EXPERIMENTAL CONSEQUENCES OF HAYAKAWA'S HYPOTHESIS ON THE ORIGIN OF HIGH-ENERGY PRIMARY COSMIC PHOTONS. J. Wdowczyk

(Univ. of Lodz, Poland). Nuovo Cimento (10), 35: 317-18 (Jan. 1, 1965).

It is shown that Hayakawa's hypothesis on the interaction of cosmic protons and photons in extragalactic space producing neutral pions has implications that are in agreement with experiment. (C.E.S.)

9957 BERYLLIUM-7 IN RAIN WATER. Yasuo Miyake and Yasuro Ohtsuka (Meteorology Research Inst., Tokyo). Papers Meteorol. Geophys. (Tokyo), 15: No. 1, 89-92(Aug. 1964).

Beryllium-7 in Tokyo rain water, which is produced in the upper atmosphere through the spallation of air molecules by cosmic rays, was determined. The content of ^{7}Be in rain water ranged from 0.7 to 5.7×10^3 atoms per millilitre, which is about the same as in other observations at different places. The calculated amount of ^{7}Be in the rain-bearing air-column above the ground is much greater in the cold frontal type of rainfall than that in the warm front. (auth)

9958 EQUATIONS FOR ONE-DIMENSIONAL CASCADE THEORY OF ELECTRON-PHOTON SHOWERS AT ARBITRARY BOUNDARY CONDITIONS AND APPEARANCE OF SOURCE FUNCTIONS. A. K. Bakhtadze. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 28-37(May-June 1964). (In Russian)

Equations were derived for a one-dimensional cascade shower theory with arbitrary boundary conditions and source functions. The general form of the particle distribution function was obtained. A new source function, which was used for the calculation of various wide atmospheric showers, was investigated. (tr-auth)

Direct Energy Conversion

Refer also to abstract 9724.

9959 (AD-421896) RESEARCH IN MHD POWER GENERATION. Semiannual Report No. 2, Period Ending June 30, 1963. (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Contract Nonr-3867(00). 118p. $10.50 (OTS).

Research into non-thermal and metastable ionization with either metal vapors, seeded gases, or rare gases is reported. The program is divided into the following subtasks: the two-inch heated shock tube, which is designed to demonstrate and to investigate the phenomena of non-thermal and metastable ionization in a magnetic field using seeded and pure rare gases; the barium diode experiment which by the method of line absorption is adapted to study non-thermal electrical discharges; the closed loop MHD experiment which utilizes seeded rare gases and is designed to investigate an MHD system in which there are no moving parts; cycle analyses of systems using MHD generators; theoretical studies of metastable ionization and magnetohydrodynamic flows under the influence of non-thermal ionization. (auth)

9960 (AD-607784) RESEARCH ON NEW CONCEPTS IN ENERGY CONVERSION. Quarterly Technical Progress Report No. 4, June 1—August 31, 1964. William D. Jackson, George A. Brown, Jack L. Kerrebrock, and E. N. Carabateas (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Sept. 15, 1964. Contract AF33(615)-1083. 28p. $2.00(OTS).

Two forms of closed-cycle magnetohydrodynamic power-generation systems and thermionic energy converters are being investigated. For a MHD machine that is not long compared with the entry length of the fluid into the traveling-field structure, there are severe discrepancies between performance calculations based on infinite and finite-length models. The solution is obtained for a finite-length MHD machine with an ideal iron core of infinite length, and with a lossless core of arbitrary permeability and infinite length. The importance of an adsorbed monolayer of cesium on the electrode surfaces in thermionic converters is treated. The relation between changes in electron work function and ionic heat of adsorption is expressed by the penetration coefficient. The work functions of the different crystallographic orientations of a single-crystal tungsten filament in vacuo are obtained. (N.W.R.)

9961 (AED-C-15-03) DIRECT CONVERSION OF NUCLEAR ENERGY INTO ELECTRIC ENERGY. Series C: Bibliographies. (Battelle Institut e. V., Frankfurt am Main). June 1964. 147p. Dep.(mn).

A total of 527 references are presented on nuclear batteries. They are arranged according to reports, conference publications, books, dissertations, patents, and journal articles. Author, report, patent, and subject indexes are included. (D.L.C.)

9962 (AFCRL-64-410) RESEARCH ON THE PRODUCTION AND PHYSICS OF SINGLE-CRYSTAL EMITTERS. Final Report. E. A. Coomes (University of Notre Dame, Notre Dame, Ind.). Apr. 20, 1964. Contract AF19(604)-8434. 25p. (AD-602713) $2.00(OTS)

Single crystals of tungsten and molybdenum from 1 to 10 cm long were produced by the Robison-plus-torsion technique in 4 to 5 mil filaments. These were studied in an improved electron projection diode, in which point-by-point and average thermionic constants could be measured on the same filament. The work functions for various directions of single crystal molybdenum were found to be the same as those single crystal tungsten. Also the average values of work function ϕ_R and A_R were 4.40 and 40 respectively, for both tungsten and molybdenum. Thermal treatment always developed facets on the crystal areas of high work function. These facets had highest thermal stability when a shingled structure developed on them during heating. (auth)

9963 (EUR-2155.e) VACUUM EMISSION DIFFUSION STUDIES OF A MOLYBDENUM EMITTER HEATED BY A URANIUM COMPOUND. H. E. J. Schins and J. Bohdansky (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 24p. Dep.(mn)

Recently the molybdenum emitter cladding a U-fuel has become of interest. Although at a temperature of 1900°K no gross attack of the Mo-emitter by the U-compounds will be found, the investigations described showed that a drift in the emitter work-function will be caused by diffusion. Several fuel-emitter configurations were operated continually at 1870°K and after 50 hr a steady state would develop. Richardson plots taken at that time had an S-shape, indicating the existence of U-patches on the Mo-surface. An orientation study of the diffusion effects was made. (auth)

9964 (IPP-3/19) ANALYSE DER WIRKUNGSWEISE VON MHD-GENERATOREN DER TYPEN A, B UND C MIT HILFE VON VEKTORDIAGRAMMEN. (Analysis of the Mechanism of MHD Generators of Types A, B, and C Using Vector Diagrams). Z. Celinski (Institut für Plasmaphysik, G.m.b.H., Garching, Germany). Mar. 1964. 18p. Dep.(mn).

The distinctions among three types of MHD generators are briefly summarized, and the assumptions made in the construction of the vector diagrams are given. The utilization of the diagrams for the determination of electrical magnitudes is illustrated. (J.S.R.)

9965 (MHD-660) EXPLOSIVE MAGNETOHYDRODYNAMICS. Second Quarterly Technical Progress Report. July 1—September 30, 1964. Malcolm S. Jones, Jr., Francis H. Webb, Jr., Paul Webster, Sydney Handlin, David Komaroff, and Guenter Guthoff (MHD Research, Inc., Newport Beach, Calif.). Oct. 14, 1964. Contract AF33(615)-1594. 72p. (AD-607518). $3.00(OTS).

Experimental and theoretical studies of explosive-driven MHD generators are reported. Experimental studies in a 1 × 4 inch linear channel have covered explosive charge geometry effects, various seed materials, plasma conductance, and a determination of the plasma inductance. A radial explosive-driven MHD generator experiment is described and theoretical relations are developed. (auth)

9966 (NASA-CR-54194) VAPOR-FILLED THERMIONIC CONVERTERS. Mid-Point Report. K. G. Hernqvist, J. R. Fendley, and J. D. Levine (Radio Corp. of America. RCA Labs., Princeton, N. J.). Sept. 1964. Contract NAS 3-4173. 73p. N64-33100). $3.00(OTS).

Electrical conductivity due to cesium adsorption on insulators has been studied extensively. For "clean" ceramic systems (defined roughly as continuously gettered systems, or closed systems in initial stages of life) conductivity of adsorbed cesium in equilibrium with cesium vapor follows a simple Arrhenius law. For "unclean" systems (defined roughly as closed systems in later stages of life where gases can accumulate) conductivity is larger and obeys a similar law. Conductivity kinetic studies show that conductivity is proportional to the fourth power of arrival rate and of time after admitting a cesium beam. But the first half monolayer of adsorbed cesium becomes electrically inert due to cesium traps. Activation energies for cesium ionization and cesium diffusion have been calculated from analyzing temperature coefficients of conductivity and conductivity drifts after shutting off the cesium beam. The above data serve as a basis for extracting cesium interactions, conduction mechanism, and binding mechanism. Plasma phenomena affecting the volt-ampere characteristic of the arc mode thermionic converter are discussed. Based on the ball-of-fire theory and including reverse current effects, an analysis is presented, which yields a relation between arc drop and the pressure spacing product. It is shown that minimum arc drop in general does not coincide with minimum electron temperature. Probe measurements of electron temperature are described. The measurements indicate electron temperature in the 3000 to 4000°K range. Various measurements of arc drop and anode work function are reported. Arc drop is found to be nearly 0.5 volt for cathode temperature in the range 1300 to 1500°K and current density of 6 to 12 amp/cm^2. Anode work function with a high cesium coverage has been found to be equal to or greater than 1.93 volt. (auth)

9967 ANALYSIS OF SOME PROBLEMS CONNECTED WITH THE ACTION OF THE MGD (MAGNETO-GAS-DYNAMIC) DIRECT-CURRENT GENERATOR. Jerzy Milewski. Prace Inst. Maszyn Przeplywowych, No. 17, 109-31 (1963).

Problems relating to direct-current magneto-gas-dynamic (MGD) generators are analyzed concentrating chiefly on the electrodes and the possibilities of using nonthermal ionization of plasma. The results of experimental work on these generators is described. The main purpose of the work is to master the chief problems in the specific technology and design of installations operating at 2,000 to 3,000°C, by building and testing a d-c "arc plasmatron" and an MGD electrode generator powered by it. The maximum arc current was 100 to 200 amp with a 50 to 150 voltage drop. The plasmatron operates properly when powered with Ar, N_2 or air. (auth)

9968 SOME ASPECTS OF NOBLE GASES MHD-GENERATOR OPERATION. V. I. Kowbasiuk, S. A. Medin, V. A. Prokudin, and S. A. Stepanov (Inst. of High Temperatures, Moscow). 21p. (CONF-640701-32).

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Properties of noble gases used as the working fluid in MHD generators are examined. Characteristics of three main types of generator are analyzed using the generalized Ohm's law with the presence of the Hall effect and ion slip. Hall generator plasma flow is examined. (H.D.R.)

9969 EXPERIMENTAL AND THEORETICAL STUDIES ON MHD POWER GENERATION. H. J. Pain, M. G. Haines and D. A. Brown (Imperial Coll. of Science and Tech., London). 7p. (CONF-640701-18)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

The theoretical aspects of the supersonic plasma flow regime in MHD power generation is compared with experimental results. A model is presented of a steady one dimensional flow of a compressible inviscid plasma across a transverse magnetic field in a rectangular channel of uniform cross section, and power generation characteristics are analyzed. (H.D.R.)

9970 PROBE MEASUREMENTS IN A CESIUM PLASMA CONVERTER. R. H. Bullis and W. J. Wiegand (United Aircraft Corp., East Hartford, Conn.). 16p. (CONF-538-2)

From 23rd Annual Conference on Physical Electronics, Cambridge, Mass., Mar. 1963.

Measurements of the properties of the plasma in the interelectrode space of both conventional and arc mode thermionic converters were obtained with coaxial electrostatic probes. In the high-temperature cesium plasma present in the converter, it was found that severe distortion of the probe current-voltage characteristic occurs due to extraneous current leakage to the probe and thermionic emission from the probe tip. By means of techniques previously reported, these distortions were eliminated by employing a coaxial type probe. A comparison of probe information is made to models of both types of converter. In the conventional mode of operation the measured electron energy distribution is Maxwellian with a temperature of 0.18 ev, which corresponds closely to the emitter temperature of 0.12 ev. In the arc mode converter, probe studies indicate that the electron energy distribution is non-Maxwellian with two energy groups existing in the plasma. The high-energy group of electrons corresponds closely in energy to emitter electrons which were accelerated by potentials comparable to emitter sheath potentials. The lower energy group corresponds to electrons that are essentially in equilibrium with the cesium vapor in the interelectrode space of the converter. The most significant factor of this information is the existence of a considerable number of electrons at energies in excess of 1.0 ev. (auth)

9971 THE POSSIBILITIES OF STRIATED LAYER MHD GENERATION. N. Fraidenraich, S. A. Medin, and M. W. Thring (Univ. of Sheffield, Eng.). 14p. (CONF-640701-24)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

It is shown that in the case of the striated magnetohydrodynamic system it is possible to obtain high η_{MHD} and high overall efficiency of the power station with a reasonable duct length. The average electric conductivity is several times greater than that calculated from the average temperature of the flow. It is profitable to work at higher combustion chamber pressures and in this case there is a minimum duct length at sufficiently high efficiencies of the magnetohydrodynamic generator. The Rayleigh-Taylor instability faces this proposal with a rather difficult problem to overcome. The analysis of it shows that there is a maximum growing rate which causes characteristic time of the disturbance to be much faster than the transit time through the duct. (auth)

9972 MINIMUM-ENTROPY-INCREASE FORMALISM FOR MHD CHOKE-FREE CONVERTER. Y. Ozawa and N. Kayukawa (Hokkaido Univ., Sapporo). 9p. (CONF-640701-17)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Minimum-entropy-increase formalism and minimization of the unused energy at the duct exit are employed in the analysis of a choke-free MHD generator. The ideal generator performance obtainable is derived and is shown to be dependent on the loading factor. (H.D.R.)

9973 THE COMBINED INFLUENCE OF HALL EFFECT, ION SLIP AND VISCOSITY ON MHD DEVICES. Tetsuo Yamanishi (Government Mechanical Lab., Tokyo). 10p. (CONF-640701-20)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

The combined influence of the Hall effect, ion slip and viscosity on the incompressible flow of viscous and weakly ionized gases under an applied transverse magnetic field is investigated. The method of complex representation is demonstrated by deriving the tensor conductivity solutions for simple flow cases from the corresponding scalar conductivity solutions. Since the scalar conductivity and the Hall coefficient for electrons are reduced by the presence of ion slip, the ion mobility effect tends to reduce the magnetohydrodynamic distortion of flow fields. (auth)

9974 PARAMETRIC STUDIES OF EXPLOSIVE-DRIVEN MHD POWER GENERATORS. M. S. Jones, Jr. and V. H. Blackman (MHD Research, Inc., Newport Beach, Calif.). 11p. (CONF-640701-25)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Characteristics of the electric output from a linear MHD channel driven by a seeded shaped charge detonated in an explosion tube are studied. Hot, partially ionized combustion gases from the detonation pass at high velocity through the power generation section where the electric power is generated by the relative motion of the ionized gas through a transverse magnetic field. The electric current is extracted by means of copper electrodes connected to an external load. The effect on electric output of variation of certain initial parameters is examined. (H.D.R.)

9975 PULSED ELECTRICAL POWER FROM CONVENTIONAL EXPLOSIVES. M. W. Burnham (Falcon R and D Co., Denver) and S. J. Marshall. 9p. (CONF-640701-23)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Problems associated with the conversion of chemical reaction energy to short-duration pulsed electric power through MHD are discussed. Particular attention is given to the properties of the conductive stream produced by conventional high explosives. Two modes of generation, the electrode mode and the electrodeless mode, are discussed in the light of the plasma properties, along with experimental results. (H.D.R.)

9976 VISCOUS HALL AND ION-SLIP EFFECTS ON MHD CHANNEL FLOW AND POWER GENERATION. James T. Yen (Catholic Univ. of America, Washington, D. C.). 8p. (CONF-640701-21)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Hall and mixed-type MHD generator configurations are analyzed by extending solutions previously obtained by Yen to include ion-slip effects. Efficiency expressions are derived and compared to previous results. (H.D.R.)

9977 CALCULATION OF THE ELECTRIC CHARACTERISTICS OF AN MHD GENERATOR WITH FINITE ELECTRODES BY CONFORMAL MAPPING UNDER FULL CONSIDERATION OF TENSOR CONDUCTIVITY AND A VELOCITY PROFILE. F. Schultz-Grunow and D. L. Denzel (Technische Hochschule, Aachen). 12p. (CONF-640701-19)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

A simplified model with a constant magnetic field extended beyond the ends of the electrodes is employed to provide a quantitative description of the electric characteristics of a MHD generator. The equivalent circuit of the generator is determined, and solutions for the inner resistance of the generator and energy dissipation within the duct as a function of the Hall coefficient and electrode dimensions are obtained. (H.D.R.)

9978 A LIQUID METAL MHD POWER GENERATION CYCLE USING A CONDENSING EJECTOR. G. A. Brown and K. S. Lee (Massachusetts Inst. of Tech., Cambridge). 8p. (CONF-640701-33)

From International Symposium on Magnetohydrodynamic Electric Power Generation, Paris.

The theory associated with a two-stage jet pump used to generate stagnation pressure in liquid-metal magnetohydrodynamic (MHD) systems is presented. The thermodynamic considerations that control the overall cycle efficiency for liquid-metal MHD power generation cycles using jet pumps are discussed. (J.R.D.)

9979 SOME EXPERIMENTS ON AN MHD GENERATOR DRIVEN BY A PLASMA JET. Toshio Ito (Mitsubishi Electric Corp., Amagasaki, Japan), Tetsuya Morikawa, Yutaka Murai, Akio Nagahiro, and Shigeaki Koide. 11p. (CONF-640701-37)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Results obtained in experiments using a magnetohydrodynamic (MHD) generator driven by a high-power plasma jet are discussed. The working fluid used was K-seeded air at 3000 to 4000°K. Electric outputs up to 10 kw were realized and properties of the working fluid were measured electrically and optically. (J.R.D.)

9980 THEORETICAL AND EXPERIMENTAL STUDIES ON INDUCTIVELY-COUPLED AC MHD CONVERTERS. Kenichi Koyama and Tadashi Sekiguchi (Tokyo Univ.). 12p. (CONF-640701-31)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

The characteristics of an inductively coupled magnetohydrodynamic (MHD) converter is analyzed. The analytical results are compared with experimental data from a small-scale experiment in which a plasma shock wave produced by a conical-type electromagnetic gun is used as a plasma source. (J.R.D.)

9981 EXPERIMENT OF GAS-FIRED MHD POWER GENERATION. Kozo Fushimi and Fusawo Mori (Ministry of International Trade and Industry, Tokyo). 9p. (CONF-640701-34)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

A magnetohydrodynamic (MHD) power generation facility is described. The behavior of materials for use in MHD generators and the characteristics of natural gas-driven generators are discussed along with measurements made during generator operation. (J.R.D.)

9982 FIXED NITROGEN BY-PRODUCTS IN OPEN CYCLE MHD GENERATORS. W. T. Lindsay, Jr., E. V. Somers, and W. S. Emmerich (Westinghouse Research and Development Center, Pittsburgh). 7p. (CONF-640701-38)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Results of calculations and preliminary magnetohydrodynamic (MHD) experiments indicate that the simultaneous production of electric power and nitrogen oxides is technically feasible with only minor modifications to the power plant, and that the economic value of MHD power generation is greatly enhanced by reclaiming the nitrogen oxide by-products. (auth)

9983 SOME FACTORS IN SEED RECOVERY. A. B. Hart, G. C. Gardner, W. D. Halstead, J. W. Laxton, and D. Tidy (Central Electricity Generating Board, Leatherhead, Surrey, Eng.). 12p. (CONF-640701-36)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

It is noted that in open ended magnetohydrodynamic (MHD) systems K compounds must be removed from duct exhaust gases before reuse. Experimental results indicate that the precipitation and condensation of K seed in the form of K_2SO_4/K_2CO_3 appears to follow conditions predicted by thermodynamic calculations (for chemical equilibria), and by theories of heat and mass transfer (for rates of deposition). There are many major engineering problems to be solved, particularly in the use and fabrication of materials to operate at very high temperatures, but it is felt that these problems can be solved for oil-fired MHD systems. (auth)

9984 SELF EXCITATION OF AN AC MPD GENERATOR. C. Carpetis, S. Kelm, and W. Peschka (Deutsche Versuchsanstalt fur Luft- und Raumfahrt ev., Porz-Wahn, Ger.). 13p. (CONF-640701-30)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

It is noted that self-excitation is possible in conventional induction generators in which Fe is used. Because of the Fe saturation the voltage-current curve is not a straight line. An intersection point between the voltage-current curve of the generator and the voltage-current of the exciting capacitors exists, and therefore self-excitation is possible. If no Fe is used in magnetoplasmadynamic generators, the voltage-current characteristic is also curved because of nonlinear behavior of the plasma. (J.R.D.)

9985 MAGNETICALLY INDUCED NON-EQUILIBRIUM IONIZATION IN CLOSED LOOP MPD POWER GENERATION. A COMPARISON BETWEEN THEORY AND EXPERIMENT. M. E. Talaat (Advanced Power Tech. Co., Inc., Bethesda, Md.). 11p. (CONF-640701-55)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Data obtained in operation of a closed-loop magnetoplasmadynamic (MPD) facility are examined. These data gave an experimental indication of the occurrence of magnetically induced nonequilibrium ionization. The runs were made at 800 to 870°K using Cs-seeded He under closed-cycle MPD generator operating conditions. A description of the MPD facility is included. (J.R.D.)

9986 ANALYSIS OF DC MHD GENERATORS WITH STATIONARY LINEAR GAS FLOW. Z. Celinski (Institut für Plasmaphysik, Garching, Ger.). 11p. (CONF-640701-111)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Types of MHD generators generally described in the literature are discussed under classifications as type A (continuous electrode generator), type B (segmented electrode generator), and type C (Hall generator). Two general types of MHD generators are introduced; the types A, B and C generators are only special cases of these general types. For a given type A, B, or C generator, the electrical variables are functions only of the load factor K and the Hall parameter β (if the gas dynamical parameters are constant). Another parameter alpha is used to characterize the electrode geometry in the general type of generator. The performance of the generator can be calculated using K, β and α as parameters. A new vector diagram technique is also used to investigate the relation between the electric field and current density vectors in an arbitrary MHD generator. (auth)

9987 THE USE OF LNG IN MHD POWER GENERATION. J. Brocoff, H. K. Orbach, V. H. Blackman, and M. S. Jones, Jr. (MHD Research, Inc., Newport Beach, Calif.). 13p. (CONF-640701-86)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Results of an economic study on the use of liquid natural gas in magnetohydrodynamic power generation are presented. Areas in which power generation economics can be improved by use of liquid natural gas are indicated. (J.R.D.)

9988 THE MHD GENERATOR IN CROSS-CONNECTION. L. S. Dzung (Brown, Boveri & Co., Ltd., Baden, Switzerland). 12p. (CONF-640701-112)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Developmental problems in cross-connected MHD generators are discussed. Fundamental equations are examined along with the effects of displacement of current paths at channel ends. External circuitry is discussed along with finite electrode breadth, potential functions at the wall zone, and cross-connection. (J.R.D.)

9989 A DESIGN CONSIDERATION ON THE OPEN CYCLE MHD POWER PLANT. Yasuji Ando (Mitsubishi Electric Corp., Amagasaki, Japan), Toshiji Omori, Hisashi Yoshii, Seigo Aramaki, Shuichiro Takahashi, Akira Sumita, and Toshio Ito. 14p. (CONF-640701-85)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Design theory of the d-c open-cycle magnetohydrodynamic generator is presented. Power losses are considered along with efficiency features of the MHD-steam power plant combination. (J.R.D.)

9990 OPERATION AND DIAGNOSTICS OF A CLOSED LOOP MPD POWER GENERATOR. R. T. Schneider and H. E. Wilhelm (General Motors Corp., Indianapolis). 12p. (CONF-640701-54)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Activities in a research program to obtain basic information on plasmas in closed-loop magnetoplasmodynamic (MPD) power generators are reported. The working fluid used in the research is Cs-seeded He. The device to be used in the research is described. The design of the research device is complicated by the need for its use as a diagnostic tool as well as a power generator. (J.R.D.)

9991 ENERGY CONVERSION WITH LIQUID METAL WORKING FLUIDS IN MHD "STAUSTRAHLROHR." R. Radebold (A.E.G., Frankfurt am Main), H. Lang, W. Westphal, and W. Lochte-Holtgreven. 20p. (CONF-640701-75)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Activities in a project to convert fission energy directly to electric power using liquid metal as the working fluid are reported. The project is based on heat production by a liquid metal-cooled reactor. The working fluid is accelerated thermodynamically to create flow through the converter where power is extracted by MHD deceleration. (J.R.D.)

9992 A NEW METHOD OF MHD POWER CONVERSION EMPLOYING A FLUID METAL. Lawrence L. Prem and William E. Parkins (Atomics International, Canoga Park, Calif.). 12p. (CONF-640701-74)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

A method of converting high-temperature heat directly to electric power in magnetohydrodynamic (MHD) cells using liquid metals as working fluid is described. Liquid- and vapor-phase metal may be used in the cycle. The fluid metal MHD power conversion system is suited to supply power at 100 kw to 100 Mw or more. (J.R.D.)

9993 DESIGN CONSIDERATIONS FOR MHD INDUCTION GENERATORS. W. D. Jackson, E. S. Pierson, and R. P. Porter (Massachusetts Inst. of Tech., Cambridge). 10p. (CONF-640701-73)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

It is noted that a-c generation of electric power from the flow power carried by electrically conducting fluid may be achieved through the use of an inductive coupling between a traveling magnetic field and the moving field. The effects of field structure permeability and conductivity are considered theoretically, and experimental results are presented for a small generator operated on NaK flow. The design implications of these results are applied to the case of a 300-kw generator. (J.R.D.)

9994 PENETRATION EFFECTS AT THE MHD INDUCTION ENGINE OF SEMI-INFINITE LENGTH. W. Peschka, S. Kelm, and F. Engeln (Deutsche Versuchsanstalt fur Luft- und Raumfahrt ev, Porz-Wahn, Ger.). 10p. (CONF-640701-32)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

A summary of theoretical studies of the end effects on magnetohydrodynamic a-c induction machines is presented. It is assumed that the generator exit is sufficiently far downstream so that exit effects may be neglected. The magnitude of the exit effects is shown to be less than that for the entrance. A carefully designed magnetic inlet is indicated to minimize end losses. Complex series of expansions for solutions of the boundary value problem and power and efficiency problems are included. (J.R.D.)

9995 MHD GENERATOR UNIT WITH INCOMPLETE COMBUSTION OF FUEL. B. Y. Shymyatsky, P. G. Poletavkin, and Y. S. Malyvgin (Inst. of High Temperatures, Moscow). 12p. (CONF-640701-44)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Designs of open- and closed-cycle magnetohydrodynamic (MHD) generators using a combustion-products-to-Ar heat exchanger are described. To maintain a noncorrosive gas on the heat-source side of the exchanger, CO and N_2 obtained from incomplete combustion of C fuels are used. The use of non-redox contact gases and refractory materials in the heat exchangers allows development of long-service MHD generators. (J.R.D.)

9996 ON THE PROBLEM OF OPTIMISATION OF MHD GENERATORS. A. V. Gubarev, B. Y. Shumyatsky, and V. V. Brejev (Inst. of High Temperatures, Moscow). 28p. (CONF-640701-43)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Results of a study are presented showing that the value of the useful power of the unit as related to the flow of the working fluid is the principal factor in optimizing magnetohydrodynamic generators. (J.R.D.)

9997 FLUID MECHANICS IN MHD GENERATORS. J. F. Louis and T. R. Brogan (Avco Corp., Everett, Mass.). 10p. (CONF-740701-39)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

The performance of magnetohydrodynamic (MHD) generators based on experience with a combustion-driven generator is examined. Results indicate the importance of a performance deterioration at low mass flow when diffusing subsonic flow exists. Data also show that the electrode losses associated with local shorting of the Hall field along the length of the electrodes are important at high Hall coefficient values for moderate values of electrode pitch to channel height. A gain in performance can be derived by establishing moderately supersonic flow in MHD generators. (J.R.D.)

9998 OPERATING EXPERIENCE OF A CLOSED-LOOP MHD TEST FACILITY. R. L. Hundstad, F. A. Holmes, and T. C. Tsu (Westinghouse Research and Development Center, Pittsburgh). 11p. (CONF-640701-49)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Constructional features and instrumentation of a closed-loop magnetohydrodynamic test facility are described. Operation during check-out tests is also described. (J.R.D.)

9999 MHD ELECTRIC POWER GENERATION BY OIL FIRING. M. Yamamoto and Y. Saito (Tokyo Shibaura Electric Co., Kawasaki, Japan). 11p. (CONF-640701-42)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Results of experimental investigations of a 10-kw magnetohydrodynamic (MHD) generator are presented. A discussion of MHD power generation by oil firing is included. (J.R.D.)

10000 LIQUEFIED NATURAL GAS APPLIED TO OXYGEN-ENRICHMENT AND MAGNET COOLING IN OPEN-CYCLE MPD POWER GENERATORS. F. J. P. Crampton and T. S. Wilkinson (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). 13p. (CONF-640701-89)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

An investigation is described in which it is assumed that optimum thermodynamic performance results from use of pure O_2 as oxidant and that liquefied natural gas is used to precool the air before separation resulting in reduced costs for the air separation unit. By solving the one-dimensional flow equations for the MPD duct, taking into account the effects of wall friction, heat loss, and isenthalpic temperature drop and with gas electric conductivity expressed as an approximate function of pressure and temperature, the net MPD cell specific power output is maximized for various values of magnet temperature. (J.R.D.)

10001 THE EXPERIMENTAL DIRECT CURRENT MAGNETOHYDRODYNAMIC GENERATOR OF THE OPEN CYCLE. W. S. Brzozowski, J. Dul, E. Fuksiewicz, M. Mikoś, and R. Wang (Inst. of Nuclear Research, Swierk, Poland). 16p. (CONF-640701-87)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

The design and construction of a magnetohydrodynamic (MHD) cell for thermal input power of approximately 1 Mw are described. The cell is to be used in evaluation of the feasibility and utility of MHD electric power generation for a future power station using oil as fuel. (J.R.D.)

10002 A SURVEY OF RESULTS OF THE C.E.G.B. PROGRAMME OF RESEARCH ON OPEN CYCLE MHD GENERATION. C. Carter, D. V. Freck, R. V. Harrowell, and J. K. Wright (Central Electricity Generating Board, Leatherhead, Surrey, Eng.). 8p. (CONF-640701-88)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

A review of research in the U. K. directed toward large-scale fossil-fueled magnetohydrodynamic (MHD) power generation is presented. Electric conductivity of seeded combustion products is discussed along with MHD duct construction, oil-fired MHD power plants, and coal combustion problems. (J.R.D.)

10003 SOME ASPECTS OF THE DESIGN OF MAGNETS FOR MAGNETOHYDRODYNAMIC GENERATORS. R. V. Harrowell and W. T. Norris (Central Electricity Generating Board, Leatherhead, Surrey, Eng.). 10p. (CONF-640701-76)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Square magnetohydrodynamic (MHD) ducts are examined in systems employing steady magnetic fields. Properties of infinitely long bundles of conductors are considered along with winding end effects. Observations on the use of iron in MHD magnets are included, and considerations of design and material choice are discussed. (J.R.D.)

10004 MHD—CHANNEL GEOMETRIES FOR NON-IRON MAGNETS. Th. Bohn and H. A. Claassen (Kernforschungsanlage, Jülich, Ger.). 10p. (CONF-640701-45)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Two channel geometries for MHD-generators with non-iron magnets are introduced: a helical channel configuration, which is adapted to magnetic field coils, and a linear coaxial one, which operates in connection with a single current carrying wire. The linear coaxial geometry was treated theoretically for small annular channel gap on the basis of a one-dimensional analysis assuming constant electrical conductivity of the working fluid and absence of Hall effect. (auth)

10005 EXPERIMENTS ON RADIANT ENERGY CONVERSION USING THIN DIELECTRIC FILMS. Benjamin H. Beam, Joseph F. Fry, and Larry D. Russell (National Aeronautics and Space Administration, Moffett Field, Calif.). New York, American Inst. of Aeronautics and Astronautics, 1964. Paper No. 64-729, 21p. $1.00. (CONF-640901-10)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

An analysis is presented of the feasibility of using thin dielectric films in thermoelectrostatic power generation for space flight applications. Theoretical calculations of available dielectric film material characteristics are tabulated, and experimental measurements are reported for five film types; polyethylene terephthalate, cyclohexane dimethylterephthalate, tetrafluoroethylene-hexafluoropropylene, polytetrafluoroethylene, and chlorotrifluoroethylene-vinylidene fluoride. (H.D.R.)

10006 MULTI-KW SOLAR CELL POWER SYSTEMS. C. L. Gould (North American Aviation, Inc., Downey, Calif.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-717, 30p. $1.00. (CONF-640901-8)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

Several recent space station studies have resulted in the selection of solar cells as the power source. Representative space vehicle requirements are reviewed and the effect of these requirements on power system optimization and design are presented. Optimization of power utilization, power conditioning, and energy storage techniques resulted in reduction of power demands to 16 kw (excluding major experiments and oxygen regeneration) for a 21-man space station. Over half of the power was required to be a-c, primarily for lights, electronics, and motors. To maximize inverter efficiency, a +28 volt, 0, −28 volt system was selected to allow an inverter input voltage of 56 volts while still having 28 volt d-c busses. Solar array deployment schemes are discussed, including designs that use either flexible, thin film solar cells or a flexible trough type concentrator that can be wrapped around the vehicle during launch. The concentrator design is thermally optimized so that power gains up to 2.4 can be obtained with concentration ratios of 2.6, correspondingly reducing the number of solar cells required. The addition of a solar dynamic or nuclear system to an orbiting station for supplemental power is suggested. This would enhance the station capability (to power additional functions such as oxygen regeneration and major experiments) and also serve as a developmental test of the supplementary unit. (auth)

10007 SOLAR THERMOELECTRIC POWER CONVERSION COUPLED WITH THERMAL STORAGE FOR ORBITAL SPACE APPLICATIONS. D. A. Naumer and J. L. McCabria (Westinghouse Electric Corp., Lima, Ohio). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-728, 27p. $1.00. (CONF-640901-11)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

The design and test programs are described for a 10 watt solar thermoelectric power system using thermal energy storage to supply heat during solar darkness and thus reduce thermal cycling and transient response. The optimum configuration of the concept is established from the standpoint of material parameters, power level, and cost. Means of optimizing individual component weight and efficiency are considered in the interest of increasing the power-to-weight ratio. Limitations of the concept are established, and problem areas are defined. (H.D.R.)

10008 ADVANCED FUEL CELL APPLICATIONS FOR SPACE MISSIONS. S. W. Coffman, Peter Fono, and C. L. Gould (North American Aviation, Inc., Downey, Calif.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-723, 12p. $1.00 (CONF-640701-4)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

The applicability of fuel cells to the system requirements of first and second generation space stations, logistic vehicles to serve these stations, space rescue vehicles, and lunar exploration programs is presented. Selection factors and sizing and weight estimates are presented for fuel cell type power systems. (H.D.R.)

10009 POWER SYSTEMS COMPARISON FOR MANNED SPACE STATION APPLICATIONS. Donald I. Southam (Thompson Ramo Wooldridge Inc., Cleveland). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-721, 26p. $1.00. (CONF-640901-5)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

A comparison of solar cell, thermionic, mercury Rankine, biphenyl Rankine, steam and Brayton solar systems along with isotope Rankine systems are analyzed at 3, 8, and 20 Kw electric. Component performance, efficiency, and weight estimates are provided for each system with consistent basic assumptions and analytical techniques in order to provide comparison validity. Criteria used for the comparisons include present development status, flight availability, system weight, collector area, radiator area, system cost, development cost, efficiency, and orientation requirements. (auth)

10010 A 30 KW POWER SUPPLY FROM THIN FILM SOLAR CELLS. Gary D. Gordon (Radio Corp. of America, Princeton, N. J.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-740, 17p. $1.00. (CONF-640901-13)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

Using 1% efficient solar cells with a power to weight ratio of 15 w/lb, a complete 30 kw power plant is proposed that would weigh about 2500 pounds. This includes the supporting structure, electric connections, sun sensor, and attitude control, which only add 25% to the weight of the individual cells; storage batteries and power regulation are not considered. Expected improvement in cell manufacture might reduce the weight to 800 pounds by the time the first array is launched. The usual concept of using thin film solar cells was to use high efficiency (5%−10%), large area cells, mounted on a rigid structure, inflatable sphere, or rotating disc. Recent system studies show advantages in using existing low efficiency (1%), small area cells, with evaporated interconnections on a single plastic substrate. A roll would be manufactured as a unit, unrolled in space, and held out by centrifugal force. Each strip will be tipped at a small angle to the spin axis, similar to a propeller, and the solar radiation pressure will point the array at the sun indefinitely. Included are the system parameters, required dynamics, attitude control effect, other effects of radiation pressure, and applicability for various missions. (auth)

10011 A SOLAR SPACE POWERPLANT WITH LIQUID METAL HEATED THERMIONIC CONVERTERS. P. Bolan (United Aircraft Corp., East Hartford, Conn.), R. Cohen, and B. Bentsen. New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-737, 12p, $1.00. (CONF-640901-14)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

A power system concept is presented in which solar energy heats a liquid metal which transfers the heat to thermal energy storage material and the thermionic converters. For shade operation, the liquid metal transfers heat from the thermal energy storage material to the converters. Satellite powerplants of 1 KW(e) output in a 300 nautical mile circular orbit are investigated. Meteoroid protection for vulnerable components is included based on a 90 percent probability of maintaining full power for 10,000 hours. A maximum operating temperature of 3000°F is assumed for directly heated converters and the liquid metal heated system is limited to 2500°F. For this study, representative thermal energy storage material properties are assumed. (H.D.R.)

10012 SOLAR THERMIONIC POWER SYSTEMS DEVELOPMENT. William J. Leovic and C. Zelman Kamien (Thompson Ramo Wooldridge Inc., Cleveland). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-735, 38p, $1.00. (CONF-640901-15)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

The results of solar evaluations of a 100 watt thermionic generator conducted under a solar flux range of 80 to 100 watts/ft^2 are presented. Generator performance optimization, misorientation, cyclic and transient response tests were accomplished. Good correlation of the generator's solar performance with laboratory performance was obtained and indicated that at the 130 watts/ft^2 solar flux level of outer space, the generator would be capable of achieving the full design power output of 100 watts. Generator power output was reduced up to 10% under a solar concentrator misorientation of 6 minutes of arc, illustrating the need for high accuracy concentrator orientation devices. In addition, results of cyclic and continuous life test of practical hardware thermionic converters are given for three design iterations. Discussion of design details, and life limiting characteristics of each design, through a two year development period illustrate the progress made in extending the continuous life operation to over 3600 hours and cyclic life operation beyond 2330 deep thermal cycles (55 minutes ON, 35 minutes OFF). These converters employ a tantalum emitter operating at a design temperature of 2000°K and a molybdenum collector at 900°K. They are rated at 16.5 watts at 1.0 volts or 24.8 watts at 0.7 volts. (auth)

10013 ELECTRICAL POWER GENERATION SYSTEM REQUIREMENTS FOR A LOGISTICS SPACECRAFT. C. Dale Haines (NASA Manned Spacecraft Center, Houston, Tex.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-720, 16p. $1.00. (CONF-640901-6)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

A description is presented of a logistics spacecraft mission, and the mission constraints within which the power generation system must function is introduced. A discussion of mission power and energy requirements is given and a mission-power profile is examined. Energy sources best suited to the power level and duration are treated. A variety of attractive energy conversion systems currently under development are discussed with emphasis on particular advantages or disadvantages for the subject mission application. An attempt is made to expose all factors pertinent to integrating an energy conversion system and all related subsystems into a spacecraft. Requirements are stressed and no attempt is made to present system weights or select a configuration. However, one possible approach to a power system configuration is presented. (auth)

Elementary Particles and Radiations

Refer also to abstracts 9588 and 10258.

10014 (IFA-HE/54) ANALYSIS OF THE ENERGY VARIATION OF BARYON BEHAVIOUR IN INELASTIC π-N SCATTERING. H. Hulubei, C. Besliu (Bucharest. Universitatea "C. I. Parhon"), A. Mihul, I. Makarovitsch, and E. Mihul (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). [1964]. 9p. Dep.(mn).

The correlation between the behavior of the elastic π–N interaction in the Bev range and the inelastic processes involved in this interaction is studied. (T.F.H.)

10015 (JINR-P-1808) ISSLEDOVANIE REZONANSOV V SISTEMAKH STRANNYKH CHASTITS I π^+,π^--MEZONOV. CHAST II. MEZONNYE REZONANSY. (An Investigation of Resonances in the Systems of Strange Particles and π^+, π^- Mesons. Part II. Meson Resonances). V. A. Belyakov, V. I. Veksler, N. M. Viryasov, E. N. Kladnitskaya, G. I. Kopylov, V. N. Penev, and M. I. Solov'ev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1964. 24p. Dep.(mn)

The resonances decaying into kaons and pions were investigated. The production cross sections for K^* (888) and κ (730) mesons in π^- p interactions at 7.5 Bev/c in the events with $K\tilde{K}$ pairs are given. The contribution (in %) of κ^0 and K^{0*} mesons in the events with ΛK pairs is estimated. The properties and the characteristics of K^{*+} meson production are described. The mass spectra of ($K2\pi$) and (K3n) systems are investigated. A possibility is indicated of the production of a new resonance $U \rightarrow K + \pi^{\pm} + \pi^{\pm} + \pi^{\mp}$ with mass 1660 Mev. Attempts were made to determine its quantum numbers. Evidence is given for the production of 1050 Mev resonance decaying into 3π mesons $\pi^{\mp}\ \pi^{\pm}\ \pi^{\pm}$, which can be identified with the A_1 meson. (auth)

10016 (JINR-P-1823) REAKTSIYA $\pi^-p \rightarrow \pi^+\pi^-n$ VBLIZI POROGA. 1. POLNYE SECHENIYA, UGLOVYE RASPREDELENIYA VTORICHNYKH CHASTITS. (The Reaction $\pi^-p \rightarrow \pi^+\pi^-n$ Near the Threshold. I. The Total Cross Sections, Angular Distributions of Secondaries). Yu. A. Batusov, S. A. Bunyatov, V. M. Sidorov, and V. A. Yarba (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 11p. Dep.(mn)

The total cross sections have been measured for six values of energy, in addition to measurements of the angular distributions of secondaries, from the reaction $\pi^-p \rightarrow \pi^+\pi^-n$ in the energy range of 200 to 300 Mev. (auth)

10017 (NP-14472) ÉTUDE ET RÉALISATION D'UN FAISCEAU DE MÉSONS K^+ de 1 Bev/c. DETERMINATION DE LA FONCTION D'EXCITATION ET DU SPECTRE D'ÉNERGIE DES MÉSONS K^+. (Study and Development of a Beam of K^+ Mesons of 1 Bev/c. Determination of the Excitation Function and Energy Spectra of K^+ Mesons). Claudine Bohy née Besson (France. Centre National de la Recherche Scientifique, Paris). Dec. 17, 1962. 130p. Dep.(mn).

Thesis submitted to Université, Paris.

The production of the beam of K^+ mesons of 1 Bev/c at the Saturne proton synchrotron was studied. General principles on the guiding of particles were defined. A method for the calculation of the different parameters characterizing the transport system was developed. The trajectories of the beam particles were studied using the floating wire method. The realization and performance of the beam were reported. The K^+ mesons were identified by time of flight and the contaminating particles were eliminated by an ethylene Cherenkov counter. The energy spectrum of the K^+ mesons produced by 2.7 Bev protons was measured. The excitation function of K^+ at 1 Bev/c was determined for five values of the energy of the incident protons, from 1.5 to 2.7 Bev. (J.S.R.)

10018 (NP-14487) ETUDE A LA CHAMBRE DE WILSON DES MODES DE DESINTEGRATIONS DU MESON LOURD K_2^0. (Study with a Wilson Chamber of Disintegration Schemes of the Heavy Meson K_2^0). Jacqueline Siaud (France. Centre National de la Recherche Scientifique, Paris). Oct. 23, 1962. 124p. Dep.(mn).

Thesis submitted to Université, Paris.

The relative proportions of the various decay modes of K_2^0 were determined. The experimental set-up and the selection rules used to determine the K_2^0 decays were described. Kinematic and dynamic analyses were made of the events. The relative proportion of lepton and non-lepton decays was established. The consequences of these proportions to the validity of the selection rules $|\Delta\vec{I}| = 1/2$ and $\Delta S/\Delta Q = +1$ were examined. (J.S.R.)

10019 (NP-14497) ETUDE DU ω^0 PRODUIT EN ASSOCIATION AVEC DES MESONS K DANS LES ANNIHILATIONS D'ANTI-PROTONS A L'ARRET (THESES). (Study of ω^0 Produced in Association with K Mesons in Annihilations of Antiprotons at Rest (thesis)). Claude Ghesquiere (France. Centre National de la Recherche Scientifique, Paris). [1961]. 120p. Dep.(mn).

Submitted to Paris. Universite.

An experimental study was made of the production of ω^0 in association with K mesons in annihilation of antiprotons. The experimental conditions and the method of studying the events were described. The properties of ω^0 were determined, and its mass and length were defined as $M_{\omega^0} = 779.4 \pm 1.1$ Mev and $0 < \Gamma_{\omega^0} < 17$ Mev. The quantum numbers were verified. The decay modes and production modes were determined. (J.S.R.)

10020 (UCRL-11328(Rev.1)) MECHANISM OF HYPERFRAGMENT FORMATION IN K^- CAPTURE. J. W. Patrick and P. L. Jain (California. Univ., Berkeley. Lawrence Radiation Lab.). Nov. 9, 1964. Contract W-7405-eng-48. 22p. Dep.; $2.00(OTS).

In an attempt to understand the mechanism of hyperfragment production, a sample of 63 parent stars of hyperfragment (HF) production has been studied. These were selected to have a fast pion or proton accompanying the HF emission. The pion charges and energy distributions as well as the proton spectrum are used to establish the HF production process. Hyperfragments are emitted preferentially opposite to the direction of emission of associated pions or fast protons. The energy spectrum of the negative pions emitted from the K^--capture stars in association with hyperfragments can be separated into two groups, the one of lower energy being larger. On the other hand, the fact that all the π^+ mesons have energies typical of the lower-energy group confirms the assumption that the π^+ must originate in association with Σ^- hyperons. It is thus deduced that a majority (71%) of the Λ's originate in Σ-conversion processes. The frequency of π^0 emission in association with hyperfragment production is evaluated. The reactions for the production of Λ's by K^- absorption on one or two nucleons are discussed. Attempts to separate K^- captures in C, N, or O from those in Ag or Br are almost completely successful. It is estimated that less than 20% of the multinucleon absorption occurs in heavy elements. (auth)

10021 (UCRL-11690) RECOIL-PROTON POLARIZATION IN π^--p ELASTIC SCATTERING AT 365 Mev (thesis). Dale Flint Dickinson (California. Univ., Berkeley. Lawrence Radiation Lab.). Nov. 11, 1964. Contract W-7405-eng-48. 56p. Dep.(mn); $3.00(cy), 2(mn) OTS.

The polarization of the recoil nucleon in π^-p elastic scattering at an incident-pion energy of 365 Mev was measured. The polarization was measured by rescattering the proton from a carbon analyzer placed between two thin-plate aluminum spark chambers, which recorded the directions of the incident and scattered protons. These spark chambers were triggered by scintillation counters, which tagged the protons as being elastic scatters undergoing interaction in the carbon plate. The spark tracks were viewed by a camera, which automatically digitized the spark coordinates and stored the information on magnetic tape for ready processing by computer. Of the 400,000 recorded events, 22,000 showed scatters; of these, 4000 were useful in the final polarization analysis. The average computer time required to process an event was approximately 30 msec. The resulting values of polarization are given. (auth)

10022 WAVE EQUATIONS IN MOMENTUM SPACE. S. Datta Majumdar (Univ. of Calcutta). Acta Phys. Acad. Sci. Hung., 18: 19-26(1964).

The behavior of wave functions in momentum space under rotation was studied. Results were used to reduce the number of independent variables in the integral wave equation for a three-particle system. (auth)

10023 INELASTIC TWO-PRONG π^--p INTERACTIONS AT 17.2 Gev IN EMULSION. G. Bozóki, E. Fenyves, Éva Gombosi, and E. Nagy (Central Research Inst. of Physics, Budapest). Acta Phys. Acad. Sci. Hung., 18: 61-6(1964).

The angular and momentum distributions of mesons (π) and protons observed in two-prong π^--p interactions in emulsions were investigated. The results gave further support to the assumption that in these events the incident pion undergoes a quasi-elastic scattering. The cross section for this process was estimated to be $\sigma \approx 2$ mb. (auth)

10024 RESTRICTIONS ON THE VERTEX FUNCTIONS. G. Pócsik (Roland Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung., 18: 73-5(1964).

It is shown that in theories possessing conserved currents the vertex functions are restricted by certain integral or differential relations. These restrictions are used for simplification of various calculations concerning electromagnetic form factors and to control the compatibility of the current conservation and the approximate vertex functions. The most general form of the electron-photon vertex could be constructed from 12 invariants. (M.C.G.)

10025 PRESSURE IN A RELATIVISTICALLY DEGENERATED FERMION GAS WITH SCALAR INTERACTION. G. Marx and J. Németh (Roland Eötvös Univ., Budapest). Acta Phys. Acad. Sci. Hung., 18: 77-82(1964).

A pressure-density relation for a fermion gas was derived from a simple model interaction in the whole relativistic domain. A zero-range interaction, the relativistic scalar version of the two-nucleon potential, was used. The dependence of pressure and energy density on particle density at zero temperature was evaluated. (M.C.G.)

10026 ČERENKOV RADIATION FROM EXTENDED CHARGE STRUCTURES. Thomas Erber and Hsio-Chang Shih (Illinois Inst. of Tech., Chicago). Acta Phys. Austriaca, 19: 17-44(1964).

Cherenkov radiation from extended charge structures is discussed using the phenomenological theory of radiation reaction. This approach leads to the conventional formulas for the radiation spectral distribution except for certain modifications incorporating the Fourier transform of the charge distribution. A few areas of application of these results are enhancement of Cherenkov radiation through particle bunching, diagnostics of the charge structure of bunched ion beams, Cherenkov radiation from neutral charge structures, e.g. excited hydrogen beams, and the measurement of nucleon form factors through vacuum polarization of Cherenkov radiation. (auth)

10027 ANGULAR CORRELATIONS IN THE REACTION $\overline{p} + d \rightarrow K^0 + \Lambda + 3\pi$. Stanislaw A. Dymus (Univ. of Warsaw). Acta Phys. Polon., 26: 189-97(Aug. 1964).

Angular correlations for the reaction $\overline{p} + d \rightarrow K^0 + \Lambda + 3\pi$ were calculated by a previously proposed method. It was assumed that in the initial state only $S_{1/2}$ and $S_{3/2}$ waves occur (the case of slow antiprotons), and that the three pions in the final state are in the resonant state ω. (auth)

10028 THE EQUATION OF MOTION FOR RELATIVISTIC PARTICLES AND SYSTEMS WITH A VARIABLE REST MASS. Kalman B. Pomeranz (City Univ. of New York). Am. J. Phys., 32: 955-8(Dec. 1964).

If the rest mass is constant the equation of motion may be presented in the form: force equals time rate of change in momentum. However, if the rest mass varies because there is an influx or efflux of mass, the equation of motion may include additional terms to account for the momentum flux. These terms are derived by applying the impulse-momentum principal and the work-energy principle. The relativistic equation of motion gives the thrust as a function of the influx or efflux velocity, the rate of mass flow, and the Lorentz factor $[1 - (v^2/c^2)]^{1/2}$ for the system. (auth)

10029 OCTUPLET TRANSFORMATION PROPERTIES OF WEAK INTERACTIONS. S. Coleman (Harvard Univ. Cambridge, Mass.), S. L. Glashow, and B. W. Lee. Ann. Phys. (N. Y.), 30: 348-59(Nov. 1964).

Transformation properties of the weak interaction Lagrangian under the group SU(3) are discussed. Selection rules (statements about the representation of the symmetry group according to which the Lagrangian transforms) and conservation laws (statements about members of the symmetry group which leave the Lagrangian invariant) are considered for leptonic and nonleptonic weak interactions. (auth)

10030 CURRENT-GENERATED ALGEBRAS. Murray Gell-Mann and Yuval Ne'eman (California Inst. of Tech., Pasadena). Ann. Phys. (N. Y.), 30: 360-9(Nov. 1964).

It is assumed that a component of the F-spin current is utilized as part or all of the vector weak current for strongly interacting particles. Likewise the same component of an axial vector current octet is assumed to be part or all of the axial vector weak current. The space integrals of the time components of these two octets then generate, by repeated equal time commutation relations, some algebra. The classification of these possible algebras is described, and some examples are given. The algebra SU(3) × SU(3) proposed earlier is not only the smallest of these possible candidates. It is also uniquely selected if the two octets exhaust the whole weak current of strongly interacting particles and if that current has the same algebraic properties as the weak current of the known leptons, in accord with the principle of universality of weak interactions. (auth)

10031 A LORENTZ-COVARIANT LOW EQUATION. B. O. Enflo (Univ. of Stockholm). Arkiv Fysik, 28: 17-35 (1964).

The Low equation is made covariant by utilizing the microcausality condition for field operators. The method leads to a new type of Born approximation, containing vertex functions, for a scattering amplitude. It also leads to an explicit formula, containing scattering amplitudes with variable pion mass, for the (n,π) intermediate state contribution to the forward scattering amplitude. The dispersion relation for forward scattering is shown to be an approximation of this covariant Low equation. (auth)

10032 ON THE MECHANICS OF PHOTON ROCKETS. P. Burcev (Purkyne Univ., Brno). Bull. Astron. Inst. Czech., 15: 79-81(1964).

The equations of motion of an ideal non-loss photon rocket are derived within the general theory of relativity. By the example of pendulum flight in an inertial system it is shown that the obtained equations lead to results concurrent with those obtained by other methods. (auth)

10033 ON THE STATISTICS OF UNSTABLE PARTICLES. Wendell Holladay and Hans C. von Baeyer (Vanderbilt Univ., Nashville). Can. J. Phys., 42: 2024-6(Oct. 1964).

A theorem providing an experimental test for the statistics of elementary particles, independent of the spin-statistics theorem, is introduced. The theorem states that in a double-decay process the permutation symmetry of the final state implies a definite permutation symmetry of the initial state. The theorem is proved, using factorization of the S matrix and the equality of the matrix elements for the two decays. (M.J.T.)

10034 ATTEMPT AT A CLASSICAL RELATIVISTIC THEORY OF QUASI-POINT CHARGED PARTICLES. Emile Durand (Université, Toulouse). Compt. Rend., 259: 3187-9(Nov. 9, 1964). (In French)

The theory of elementary charged particles in which they are no longer considered as rigorous points but with the electric charge distributed throughout the space and with a very strong accumulation in the vicinity of the center of gravity was generalized to the case where the charge is in movement. (J.S.R.)

10035 ON RESONANCES AND REGGE PARTICLES. J. Patera and P. Smrz (Joint Inst. of Nuclear Research, Dubna, USSR). Czech. J. Phys., 14: 733-7(1964).

The description of resonances by the method of Regge poles is discussed. It is found that the resonance part of the scattering amplitude can satisfy the unitarity condition if certain relations between the trajectories and the residue of the Regge poles are fulfilled. The influence of the empirical assumption of the nonexistence of resonances with $T = 3/2$, $J = 1 \neq 1/2$ and $T = 1/2$, $J = 1 + 1/2$ is discussed for πN scattering. On such an assumption the unitarity condition leads to a relation between trajectories with different isotopic spin which does not conflict with the experimental results. (auth)

10036 DECAY RATE OF A BOUND μ-MESON. A. Vančura (Technical Univ., Prague). Czech. J. Phys., 14: 738-40(1964).

The decay rate of the bound μ meson is calculated in the framework of the theory of weak interactions with spin-zero intermediate boson. It is shown that the rate decreases monotonically with the atomic number of the μ-mesic atom, as required by experiment. (auth)

10037 ON THE ELASTIC SCATTERING OF PROTON ON DEUTERON AT AN ENERGY OF 8.2 Gev. Z. Korbel (Technical Univ., Prague). Czech. J. Phys., 14: 741-52 (1964).

The elastic scattering of protons on deuterons at 8.2 Bev was studied by the method of nuclear photoemulsions. A stack composed of 20 emulsions of the type NIKFI-R diluted with heavy water was irradiated with the internal proton beam on the synchrophasotron in the Joint Institute of Nuclear Research. The beam was perpendicular to the plane of the emulsion and had an intensity of $(3.36 \pm 0.10) \times 10^{8}$ protons/cm^2. Altogether 114 (p-d) and (p-p) events of elastic scattering were found. The differential cross section of elastic scattering (p-d) was determined in a range of scattering angles of 1.3 to 10° in cms. The total cross section of elastic scattering (p-d) in this range of angles was found to be (9.74 ± 1.10) mb. The effective radius of interaction between the proton and deuteron during elastic scattering was found to be $(2.25 \pm 0.10) \times 10^{-13}$ cm. (auth)

10038 THE ROLE OF UNSTABLE PARTICLES IN $\pi\pi$ INTERACTIONS. A. A. Afonin and Ya. I. Granovskii. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk, No. 1, 9-21 (Jan.-Apr. 1964). (In Russian)

Elastic and inelastic π-π interactions and their structure and form factors were studied considering unstable states of π-π system and the effects of unstable particles on the π-π interactions. (R.V.J.)

10039 DISPERSION RELATIONS FOR K MESON SCATTERING ON NUCLEONS. Ya. I. Granovskii and A. A. Pantyushin. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk, No. 1, 22-30(Jan.-Apr. 1964). (In Russian)

It is shown that meson (K)-nucleon-scattering amplitudes with assigned isospin magnitudes are described by the virtual part of K-N scattering, which has an identical isospin magnitude and by combination of virtual parts of K-N scattering amplitudes with various isotopic spins. Isotopic amplitudes in the Born approximation and partial amplitudes were analyzed. (R.V.J.)

10040 MODEL OF $K\pi$ SCATTERING THROUGH VECTOR UNSTABLE MESONS. Ya. I. Granovskii and A. A. Pantyushin. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk, No. 1, 31-7(Jan.-Apr. 1964). (In Russian)

K-π interactions were analyzed taking into account the exchange with unstable vector mesons. A diagram was developed for the resonance K-π scattering processes (with K′ meson exchange) and symmetric approximation. (R.V.J.)

10041 COVARIANT HIGHER-SPIN EQUATIONS. R. A. Berg (Lockheed Aircraft Corp., Palo Alto, Calif.). J. Math. Phys. (N. Y.), 6: 24-33(Jan. 1965).

Covariant wave equations are derived for nonzero-mass particles of arbitrary spin, with wave-functions that involve no redundant components. The Dirac equation is seen to be the first of these, for spin $1/2$; the Proca vector meson equations for spin 1 are the next set. The derivation is based on synthesizing higher-spin particles from particles of lower spin. (auth)

10042 SUMMATION OF PARTIAL WAVES. Henry Brysk (Adelphi Univ., Garden City, N. Y.). J. Math. Phys. (N. Y.), 6: 51-4(Jan. 1965).

For high-energy potential scattering, when the partial wave expansion converges too slowly to be directly useful, a technique is proposed for extracting the differential cross section more effectively from the phase shifts by means of a weight-function and orthogonal-polynomial approach. (auth)

10043 SUFFICIENT CONDITIONS FOR AN ATTRACTIVE POTENTIAL TO POSSESS BOUND STATES. Francesco Calogero (Università, Rome and Istituto Nazionale di Fisica Nucleare, Rome). J. Math. Phys. (N. Y.), 6: 161-4 (Jan. 1965).

Simple conditions on the potential are given, which are sufficient to secure the existence of at least one bound state for each angular momentum $l \leq L$. One such condition is given by the inequality $-\int_0^R dr\, rV(r)\, (r/R)^{2L+1} - \int_R^\infty dr\, rV(r)\, (R/r)^{2L+1} \geq 2L + 1$, where R is an arbitrary radius and V(r) an everywhere attractive potential. Upper bounds on the energy of the lower bound state for each angular momentum are also given. (auth)

10044 A TWO-BODY METHOD FOR THE BOUND STATES OF A THREE-BODY SYSTEM. J. W. Murphy and S. Rosati (Univ. of Manchester, Eng.). Nucl. Phys., 63: 625-33(Mar. 1965).

Coupled, effective, two-body Schrödinger equations are obtained for a three-particle system with arbitrary orbital and spin angular momenta, assuming that the dependence of the wave function on the interparticle distance is of the product form $u(r_1, r_2, r_3) = \Pi^{3}{}_{i=1} g_i(r_i)$. The expectation value of the kinetic energy, expressed in triangular coordinates, is given in a form suitable for computation. A series of approximations is discussed to account for the possibility that the wave function contains a spurious part. (auth)

10045 THE β-DECAY PROCESS IN ONE, TWO AND THREE-NUCLEON SYSTEMS. R. J. Blin Stoyle and S. Papageorgiou (Univ. of Sussex, Eng.). Nucl. Phys., 64: 1-7(Apr. 1965).

A comparison of the ft values for the ^3H and neutron β decays is used to estimate the magnitude of mesonic exchange effects in the axial vector interaction. These effects are represented by a phenomenological operator whose contribution to the $p + p \rightarrow d + e^+ + \nu$ process is then evaluated. Exchange effects in this process turn out to be approximately seven times smaller than in the β decay of the triton. (auth)

10046 NUCLEON CORE AND LOW ENERGY PHENOMENA. [PART] II. K. V. Laurikainen and E. I. Peltola (Univ. of Helsinki). Nucl. Phys., 64: 89-96(Apr. 1965).

A two-nucleon potential of the following form was studied: the one-pion exchange potential (OPEP) + two finite rectangular cores, corresponding to the central and the tensor part of the OPEP, both cores having the same range. Two solutions fitting the deuteron properties were found, one with strongly attractive, the other one with repulsive cores. The last can also be chosen to fit experimental data on triplet even scattering to 150 Mev. (auth)

10047 THE Ω^-: A SPECTACULAR DISCOVERY. B. Diu and H.-R. Rubinstein (Laboratoire de Physique Theorique et Hautes Energies, Orsay, France). Nucleus (Paris), 5: 274-80(July-Aug. 1964). (In French)

The particular importance of the experimental detection of the Ω^- is indicated by a review of the history of particle physics since the introduction of quantum mechanics. The general principles in the classification of particles are summarized, and the unitary system is described. (J.S.R.)

10048 MOMENTUM SPECTRUM OF π-MESONS PRODUCED IN INTERACTIONS OF NUCLEONS WITH ENERGY OF THE ORDER OF SEVERAL HUNDRED Gev. N. A. Dobrotin, N. G. Zelevinskaya, V. M. Maksimenko, V. S. Puchkov, and S. A. Slavatinskii (Lebedev Inst. of Physics, Moscow). Nukleonika, 9: 233-44(1964). (In Russian)

Data presented by V. V. Gusev et al. (Izv. Akad. Nauk USSR 26: No. 5, (1962)) showed that the predominant number of mesons (π) produced by nucleon-nucleon collisions at 300 Bev were produced in one meson jet moving along nucleon motion in relation to the relative center-of-inertia of colliding nucleons (C system). The meson (π) production frequency and the possible mechanisms of production were studied with two Wilson cloud chambers and an ionization calorimeter 3860 m above sea level. The energy of the primary particle (judged by the total energy in the ionization calorimeter), the number of particles generated by the interaction, the emission angle of secondary particles, and the meson (π) momentum according to the particle tracks in the Wilson chamber placed in a magnetic field were determined. The relation between the transverse isobar and the transverse fission product momentum was also determined. The maximum energy of the second meson (π) in the laboratory coordinate system was 40 to 50% that of the initial particle. (R.V.J.)

10049 STUDY OF THE REACTION $\pi^-p \rightarrow \mathcal{N}_{33}^{*++}\pi^-\pi^-$ AND $\pi\pi$ ELASTIC SCATTERING. J. Alitti (CEN, Saclay, France), J. P. Baton, A. Berthelot, B. Deler, W. J. Fickinger, N. Neveu-Rene, V. Alles-Borelli, R. Gessaroli, A. Romano, and P. Waloschek. Nuovo Cimento (10), 35: 1-12(Jan. 1, 1965).

Approximately 3500 four-prong events, observed in the Saclay 81 cm LHBC exposed at the CERN PS to a beam of 2.75-Bev/c mesons (π^-) were analyzed; the cross sections for the different multipion channels were determined. A total of 1324 events corresponds to the reaction $\pi^- + p \rightarrow \pi^- + p + \pi^- + \pi^+$ which is characterized by an important production of the $\mathcal{N}_{33}^{*+}$ isobar ($\sigma = 0.61$ mb) and of the ρ^0 resonance ($\sigma = 0.36$ mb). The $\mathcal{N}_{33}^{*+}$ isobar appears to be mainly produced according to an OPE mechanism. The $\sigma_{\pi\pi}$ elastic cross section in a pure T = 2 state is evaluated as a function of the dipion energy; scattering angular distributions for different ($\pi^-\pi^-$) mass intervals are also analyzed. (auth)

10050 THE TWO-PION-EXCHANGE CONTRIBUTION TO $\mathcal{N}$-Λ AND Λ-Λ INTERACTIONS. I. THE POTENTIALS. M. Rimpault and R. Vinh Mau (Faculte des Sciences, Bordeaux). Nuovo Cimento (10), 35: 85-107(Jan. 1, 1965).

The two-pion-exchange $\mathcal{N}$-Λ and Λ-Λ scattering amplitudes are calculated on the basis of the Mandelstam representation. The results contain parameters referring to the $\mathcal{N}_{3,3}^*$ and Y_1^* baryon excited states and the pion-baryon coupling constants. The effects of π-π interaction are also discussed. The $\mathcal{N}$-Λ and Λ-Λ potentials are then derived from these field-theoretic scattering amplitudes. The shapes of the various parts (central, spin-spin, tensor, spin-orbit, both symmetric and antisymmetric for the $\mathcal{N}$-Λ case) of these potentials are presented. (auth)

10051 27 → B + P DECAYS OF $^3/_2{}^+$ BARYON RESONANCES IN BROKEN SU_3 SUMMETRY. R. Acharya Northeastern Univ., Boston). Nuovo Cimento (10), 35: 108-13(Jan. 1, 1965).

The decays of $^3/_2{}^+$ baryon resonances comprising the 27-plet representation of unitary symmetry, into baryon and pseudoscalar meson octets, is considered under the assumption of a first-order breakdown of the symmetry. There are 24 possible decays which are described in terms of 7 parameters. This leads to 17 coupling constant sum rules. (auth)

10052 CONSEQUENCES OF A WEAK VECTOR BOSON IN RADIATIVE MUON DECAY. Edw. S. Ginsberg and R. H. Pratt (Stanford Univ., Calif.). Nuovo Cimento (10), 35: 114-19(Jan. 1, 1965).

Consequences of a weak vector boson, W, for radiative muon decay $\mu \rightarrow e + \nu + \bar{\nu} + \gamma$ are calculated, including the effects of anomalous electromagnetic properties for the W-boson. All effects are small, of order $\lambda = m_\mu^2 m_W^{-2}$, relative to the spectrum in the absence of a W-boson. This is consistent with present experiments. (auth)

10053 $P_{3/2}$ $\bar{K}\mathcal{N}$ SCATTERING IN THE T = 1 STATE AND THE Y_1^* REGGE POLE. S. Rai Choudhury (Univ. of Delhi). Nuovo Cimento (10), 35: 120-4(Jan. 1, 1965).

Assuming that the $P_{3/2}$, T = 1, Y_1^* is a Regge particle, the $\bar{K}\mathcal{N}$ scattering amplitude is calculated through the Regge-Khuri representation. The results are in good agreement with solution A of Watson. (auth)

10054 CALCULATION OF REGGE POLES BY CONTINUED FRACTIONS. [PART] II. D. Masson (Univ. of Toronto). Nuovo Cimento (10), 35: 125-49(Jan. 1, 1965).

An expansion of the Regge trajectories for large energy is derived for singular and nonsingular potentials. The Pade approximate is introduced in order to sum these asymptotic expansions. Further calculations for a Yukawa potential are reported with emphasis on the analytic properties of the trajectories. All the trajectories investigated have singularities not present in the S-matrix itself. It is concluded that one can analytically continue from one trajectory to another. (auth)

10055 DIRECT INTERACTION FOR PRODUCTION OF (3,3) RESONANCE BY NEUTRINOS. D. L. Weaver, H. S. Song, C. L. Hammer, and R. H. Good, Jr. (Ames Lab., Ames, Iowa). Nuovo Cimento (10), 35: 150-9 (Jan. 1, 1965). (IS-910)

A discussion of the unique direct interaction hamiltonians for the processes $\nu + p \rightarrow \mathcal{N}^* + \mu^-$ and $\bar{\nu} + p \rightarrow \mathcal{N}^* + \mu^+$ is presented. The cross section is found to increase as the square of the neutrino energy, in agreement with the CERN experiment. The same interaction as for the $\bar{\nu} + p \rightarrow \mathcal{N}^* + \mu^+$ process is used to find the energy spectrum of the emitted leptons in the weak decay $\Omega^- \rightarrow \Xi^0 + \bar{\nu} + 1^-$. The transition probability is estimated to be two orders of magnitude smaller than that of the mesic decay modes. (auth)

10056 ANALYSIS OF S-MATRIX SINGULARITIES BY MEANS OF OPERATOR TECHNIQUE. M. Clafaloni (Scuola Normale Superiore, Pisa, Italy) and P. Menotti. Nuovo Cimento (10), 35: 160-93(Jan. 1, 1965).

The problem of determining the singularities of the S-matrix for a given angular momentum in the k-plane, is reduced to an eigenvalue problem for compact operators. In particular the dependence of the position of singularities on the strength of the potential is examined. The position of the antibound states is connected in a simple way to that of the bound states and explicit bounds are given for the position of the resonances. (auth)

10057 COMPOSITE PARTICLE AND ASYMPTOTIC BEHAVIOR. J.-C. Houard (Collège de France, Paris). Nuovo Cimento (10), 35: 194-207(Jan. 1, 1965). (In French)

The renormalized propagator of the V-particle in the Lee model satisfies a spectral representation which, in the case of a composite particle, differs from the classical representation of Lehmann. In addition to the usual spectral integral, a constant term appears which modifies the asymptotic behavior. It is shown that this term is related to the equal-time commutator which occurs in the dispersion relations, and a test of elementarity based on the presence of this commutator is discussed. However, in the case of an elementary particle, the test is weakened by the existence of a resonance at the bare mass of the V-particle. (auth)

10058 LARGE-ANGLE CROSS-SECTIONS $p + p \rightarrow A + B$ AND $\pi + p \rightarrow A + B$ AT HIGH ENERGIES PREDICTED BY

THE STATISTICAL MODEL. R. Hagedorn (CERN, Geneva). Nuovo Cimento (10), 35: 216-26(Jan. 1, 1965).

Large-angle cross sections $p + p \to A + B$ and $\pi + p \to A + B$ are predicted using the statistical model. A condition for central collisions is formulated which, together with the relative probability $P_{\mathrm{elastic}}/(\Sigma P)_{\mathrm{all\ channels}}$, leads to a relation between the above large-angle cross sections and the total inelastic cross sections for pp and πp collisions. It is found that all these cross sections, taken at c.m. scattering angles near 90°, decrease exponentially with the total c.m. energy. For $p + p \to p + p$ a comparison with recent experiments shows good agreement over a range where this cross section varies by five powers of ten. (auth)

10059 ELECTRON-POSITRON MODEL FOR THE CHARGED MESONS AND PION RESONANCES. E. J. Sternglass (Westinghouse Research Labs., Pittsburgh). Nuovo Cimento (10), 35: 227-60(Jan. 1, 1965).

The relativistic electron-pair model for the neutral pion developed earlier is extended to arrive at models for the charged mesons. The addition of the third electron or positron to the singlet state of the π^0 system results in a charged particle of spin $1/2$ whose mass and magnetic moment agree closely with the observed $\mu^{\pm}$-meson properties. A calculation of the lifetime against the emission of two quanta of spin $1/2$ by the neutral core of this system, taking account of the relativistically increased mass of the radiating pair, leads to agreement with the observed μ-meson lifetime. The excited states of this system are found to be quantized in units of $(\hbar/2)$, and the first of these is found to fit the observed properties of the $\pi^{\pm}$, including its mass, spin, and lifetime for decay to the $\mu^{\pm}$ state with the emission of a spin-$1/2$ quantum or neutrino. The electromagnetic interaction between any two pions is examined and found to have the observed strength and short range of nuclear forces, independent of the charge state of the meson. By contrast, the interaction of muons with pions is shown not to lead to strong binding, thus accounting for the observed difference in the interaction of these two particles with matter. An examination of simple multi-pion systems leads to 2π, 3π, and 4π molecular-type structures whose ground states reproduce the observed spins and masses of the K and η mesons, while the excited rotational states account for the known masses and angular momenta of all the pion-resonance systems observed so far. (auth)

10060 ELASTIC PHOTON-DEUTERON SCATTERING AND THE NUCLEON POLARIZABILITY. A. Tenore (CNEN, Rome) and A Verganelakis. Nuovo Cimento (10), 35: 261-78(Jan. 1, 1965).

An analysis of the existing experimental data on the elastic scattering of photons by deuterons, is carried out in the framework of the impulse approximation. Nevertheless, it also attempts to take into account certain effects which are not given by the impulse approximation. Including these effects, the prediction of the theory on the deuteron Compton effect was improved. Based on this analysis an estimation of the neutron electric polarizability is made. It was found to be $\sim 1.2 \times 10^{-42}$ cm^3. Experiments in proton, deuteron, and ^{4}He Compton effect with polarized γ's are discussed for a better specification of the polarizabilities of the proton and neutron as well. (auth)

10061 REGGE-POLE KINEMATICS. G. Mohan (National Physical Lab., New Delhi). Nuovo Cimento (10), 35: 284-91(Jan. 1, 1965).

The kinematics of the Regge-pole amplitude and the partial-wave amplitude in the study of the scattering of particles of high spins is evolved from the spinless case through a simple differentiation procedure. In particular, the Regge-pole contribution, suitably modified to conform to the basic Mandelstam cut structure, to the scattering amplitude of arbitrary helicities is constructed. A new modified Regge-pole contribution with square-root branch point is proposed. (auth)

10062 THE CONTRIBUTION OF ONE-BARYON EXCHANGE TO THE REACTIONS $ps + B \to V + B$. C. H. Chan and Y. S. Liu (Middle East Technical Univ., Ankara). Nuovo Cimento (10), 35: 298-307(Jan. 1, 1965).

The reactions in which a pseudoscalar meson interacts with a baryon to yield a vector meson and another baryon are studied in terms of peripheral model. Baryon exchange as well as meson exchange are considered. Comparison with experimental result on $\pi^+ + p \to \Sigma^+ + K^*$ at 2.77 Bev/c is made, and it is found that in order to fit the angular distribution of the K* and to obtain cross sections compatible with experiments, form factors of the exponential type have to be used. (auth)

10063 EFFECTS OF THE PION-EXCHANGE CURRENT ON THE ELASTIC ELECTRON-DEUTERON SCATTERING, AND THE ELECTROMAGNETIC STRUCTURE OF THE NEUTRON. H. Yokomi (Osaka Univ.). Nuovo Cimento (10), 35: 313-16(Jan. 1, 1965).

The difference in the value of the neutron form factor as determined in elastic and inelastic electron-deuteron interactions are considered. It is pointed out that the difference could disappear if the effects of the meson (π) exchange current on the elastic cross section are considered as a correction for the impulse approximation. Since the deuteron has isotopic spin zero, only the odd-meson (π) current contributes to elastic scattering by the requirements of G-invariance. The contribution of the most simple 3-meson (π) exchange current is studied through the effective γ-3π interaction hamiltonian. (C.E.S.)

10064 INTERACTIONS OF 900 Mev/c K$^+$ ON NUCLEI LEADING TO THE PRODUCTION OF ONE PION. E. Fiorini (Istituto di Fisica, Milan and I.N.F.N., Milan), A. Pullia, A. Bezaguet, and P. Musset. Nuovo Cimento (10), 35: 319-21(Jan. 1, 1965).

An analysis was carried out on inelastic interactions by a 900 Mev/c meson (K$^+$) beam in a heavy-liquid bubble chamber. The interactions $K^+ + n \to K^+ + \pi^- + p$, $K^+ + N \to K^0 + \pi^+ + N$, and $K^+ + p \to K^+ + \pi^+ + n$ were analyzed. A search was made for possible resonances in the $(\pi^- K^+)$, $(\pi^+ K^+)$, and $(\pi^+ K^0)$ systems, but no evidence was found for the recently reported meson (κ). From the analysis of the angular and four-momentum-transfer distributions, an indication for the contribution of peripheral processes was obtained. (C.E.S.)

10065 THEORETICAL MODEL FOR $\pi + \mathcal{N} \to \mathcal{N} + \eta$. G. Altarelli, F. Buccella, and R. Gatto (Università, Florence and C.N.E.N., Rome). Nuovo Cimento (10), 35: 331-5 (Jan. 1, 1965).

The charge symmetric reaction $\pi^+ + n \to p + \eta$ is considered. Previous experimental data indicate a very fast rise of the cross section soon after threshold followed by a slow decrease. A model for this reaction, which provides a reasonable fit to the data, is developed. (C.E.S.)

10066 THREE-QUANTUM ANNIHILATION OF POSITRONS IN ALKALI HALIDES. A. Gainotti, E. Germagnoli, G. Schianchi, and L. Zecchina (Università, Parma, Italy). Phys. Letters, 13: 9-10(Nov. 1, 1964).

A systematic investigation was undertaken in order to determine whether the previously reported large probability of three-quantum annihilation of positrons in alkali halides is to be attributed to structural irregularities or to the bulk properties. The experimental values of the probability of three-quantum annihilation are presented. It is concluded that the behavior of positrons in alkali halides is a consequence of bulk properties with impurity states and grain boundaries being of minor importance. (C.E.S.)

10067 A RELATIVISTIC THREE-BODY PROBLEM. D. Stojanov and A. N. Tavkhelidze (Joint Inst. for Nuclear Research, [Dubna], USSR). Phys. Letters, 13: 76-7(Nov. 1, 1964).

The possibility of obtaining Fadeev type equations for studying the relativistic three-body problem is discussed. (C.E.S.)

10068 PROTON-PROTON SCATTERING AT VERY SMALL ANGLES AT 24 Gev/c. E. Lohrmann (Physikalisches Staatsinstitut, Hamburg and DESY, Hamburg), H. Meyer, and H. Winzeler. Phys. Letters, 13: 78-80(Nov. 1, 1964).

The angular distribution of elastic p-p scattering was measured at very small angles in a region where the contribution of the Coulomb amplitude becomes considerable to determine the real part of the nuclear elastic scattering amplitude. The experiment was performed at 24.0 Bev/c primary momentum with a hydrogen gas target and nuclear emulsions as detectors. (C.E.S.)

10069 SPARK CHAMBER STUDY OF HIGH-ENERGY NEUTRINO INTERACTIONS. J. K. Bienlein, A. Boehm, G. Von Dardel, et al. (CERN, Geneva). Phys. Letters, 13: 80-6(Nov. 1, 1964).

A previous experiment demonstrated that neutrinos from π-μ decay ν_μ are different from β-decay neutrinos ν_e. An experiment that confirms this result with considerably increased statistics is reported. Elastic electron production was observed at a rate compatible with the amount of neutrinos from K-e decays in the beam. The measured rate excludes the possibility that neutrinos from $K_{\mu 2}$ decay are identical to ν_e. The measured ratio of μ^+ to μ^- production provides a test on lepton conservation. From the angular distribution of elastically produced mesons (μ) a cut-off in the axial vector form a factor close to the one in the vector part is inferred. The electron events show structure effects similar to those in the meson (μ) case. (C.E.S.)

10070 SEARCH FOR INTERMEDIATE BOSON PRODUCTION IN HIGH-ENERGY NEUTRINO INTERACTIONS. G. Bernardini, J. K. Bienlein, G. Von Dardel, et al. (CERN, Geneva). Phys. Letters, 13: 86-91(Nov. 1, 1964).

If weak interactions are mediated by a boson W, it should be produced in high-energy neutrino experiments provided its mass is not too high. The reaction is $\nu_\mu + Z \rightarrow W^+ + \mu^- + Z$ where Z is a nucleus or a proton. The boson would then decay within 10^{-18} sec into a neutrino and a charged lepton or into a system of pions or kaons, i.e., $W^+ \rightarrow \mu^+ + \nu_\mu$, $W^+ \rightarrow e^+ + \nu_e$, or $W^+ \rightarrow$ pions and/or kaons. A systematic search was made for lepton pairs, $\mu^-\mu^+$ and μ^-e^+, that would show up as a result of the reactions, and conclusions were drawn concerning the lower limit of the mass of the intermediate boson. (C.E.S.)

10071 SMALL ANGLE PROTON–PROTON SCATTERING AT 7.85 Gev/c. A. E. Taylor (Atomic Energy Research Establishment, Harwell, Berks, Eng.), A. Ashmore, W. S. Chapman, D. F. Falla, W. H. Range, D. B. Scott, A. Astbury, F. Capocci, and T. G. Walker. Phys. Letters, 14: 54-6(Jan. 1, 1965).

The results of an experiment designed to measure the absolute values of the forward differential cross sections in proton-proton scattering at 7.85 Bev/c in the nuclear-Coulomb interference region are reported. The ratio of the real and imaginary parts of the nuclear scattering amplitude was found to be -0.29 ± 0.03. (C.E.S.)

10072 SYMMETRY GROUP CONTAINING LORENTZ INVARIANCE AND UNITARY SPIN. T. Fulton and J. Wess (Universität, Vienna). Phys. Letters, 14: 57-60(Jan. 1, 1965).

A previously proposed group, $\mathscr{G}_6$, embodying both ordinary spin and SU(3) to account for the symmetries of the strongly interacting particles is discussed. The group $\mathscr{G}_6$ is some extension of the inhomogeneous Lorentz group, L, by means of the unitary spin group, and its little group is [SU(6)]q, where q is the momentum. In view of the remarkable success in applying [SU(6)]q to the elementary particle spectrum, the difficult question of the Lorentz invariance of $\mathscr{G}_6$ becomes a crucial one. An approach to the problem of Lorentz invariance is proposed. Rather than studying $\mathscr{G}_6$, a simple formal generalization of L to a group $\mathscr{G}$, different from $\mathscr{G}_6$, which has L as a subgroup and [SU(6)]q as a little group, is considered. The generators of L commute with those of SU(3). It is also shown that the pseudoscalar octet and vector nonet mesons can be put into a manifestly L covariant representation which reduces to the thirty-five dimensional representation previously proposed for these particles. (C.E.S.)

10073 PC VIOLATION AND WEAK PION PRODUCTION. E. Giusti (Università, Florence) and G. Karpman. Phys. Letters, 14: 60-2(Jan. 1, 1965).

Previous calculations on the weak meson (π) production reaction $\nu + N \rightarrow l + N' + \pi$ are investigated taking into account PC violation. The intermediate vector meson is introduced into the calculations, and the four-particle problem (NNWπ) is considered. The case in which the lepton is an electron is considered, and the form factor of the PC violating term is obtained from the expression for the total cross section. (C.E.S.)

10074 POSSIBLE DETECTION OF INTERMEDIATE BOSONS THROUGH ANTIPROTON ANNIHILATION. A. Weis and P. Kabir (Universitet, Copenhagen). Phys. Letters, 14: 62-4(Jan. 1, 1965).

It is a fairly widespread belief that weak interactions are transmitted through an intermediary field whose quanta are called intermediate bosons. The paucity of events characteristic of such particles in the CERN neutrino experiment and the consequent lower limits of 1.3–1.8 Bev for their mass make it desirable to find alternative methods of searching for intermediate bosons of higher mass. It is proposed that such intermediate bosons W may possibly be detected through the resonant reactions $\overline{p} + n \rightarrow W^- \rightarrow l^- + \overline{\nu}$, where l stands for a meson (μ) or an electron, if the leptonic channels comprise a major decay mode (i.e., with a branching ratio of ten percent or more) of W decay. (C.E.S.)

10075 PARITY-VIOLATING AMPLITUDES OF NONLEPTONIC DECAYS IN SU_6 SYMMETRY. M. Suzuki (Tokyo Univ.). Phys. Letters, 14: 64-6(Jan. 1, 1965).

Consequences of the spin and unitary spin independence in the nonleptonic decays of the hyperons are discussed. It is assumed that the strong interactions are invariant under SU_6 transformations associated with the spin and unitary spin independence and that the spurion emitted in the nonleptonic decays transforms like the $\overline{K}^0$ meson at rest under SU_6. The discussion is restricted to the parity-violating amplitudes of the nonleptonic decays. (C.E.S.)

10076 A CONNECTION BETWEEN THE RATIO ReA(s,o)/ImA(s,o) AND THE HIGH-ENERGY PION-NUCLEON TOTAL CROSS SECTION. [PART] II. P. Olesen (Universitet, Copenhagen). Phys. Letters, 14: 66-7(Jan. 1, 1965).

It was previously shown that if $\sigma_\pm(\omega)$ approach $\sigma_\pm(\infty) \neq 0$ at least as fast as $1/\omega$, then the ratios $\alpha_\pm = [\mathrm{ReA(s,o)}/\mathrm{ImA(s,o)}]_{\pi^\pm p}$ cannot tend to nonvanishing values as $\omega \rightarrow \infty$. On the other hand, if $\sigma_\pm(\infty) = 0$ the quantities $\sigma_\pm \rightarrow$ constant for $\omega \rightarrow \infty$. Such a behavior contradicts cosmic ray data. The condition on the quantities $\delta\sigma_\pm(\omega) = \sigma_\pm(\infty) - \sigma_\pm(\omega)$ is actually too restrictive. It is pointed out that a power-like decrease of the functions $\delta\sigma_\pm(\omega)$ is allowed. This case is interesting since one cannot exclude from cosmic ray data that $\sigma_\pm(\omega)$ decrease logarithmically. The result is that a logarithmic decrease is incompatible with $\alpha_\pm \neq 0$ for $\omega \rightarrow \infty$. (C.E.S.)

10077 COVARIANT MERGING OF SPIN AND UNITARY SPIN. P. Roman and J. J. Aghassi (Boston Univ.). Phys. Letters, 14: 68-70(Jan. 1, 1965).

Previous progress toward the unification of internal and external symmetries is considered, and it is pointed out that the lack of covariance is the main difficulty in the scheme. A possible covariant generalization is proposed. This is based on the observation that the inhomogeneous Lorentz group, including reflections, $I\mathscr{G}_4'$, can be considered as the limit of a De Sitter group whose group space is embedded in a flat 5-dimensional space-time, becoming the 4-surface of a sphere with $R \rightarrow \infty$. The Lie ring of this $\mathscr{G}_5$ group can be constructed by considering its fundamental 4-component spinor representation, the generators of which are made up of two independent sets of 2 × 2 Pauli matrices. (C.E.S.)

10078 SU_6 AND NON LEPTONIC HYPERON DECAYS. G. Altarelli (Università, Florence), F. Buccella, and R. Gatto. Phys. Letters, 14: 70-2(Jan. 1, 1965).

It is shown that from the assumption that the s-wave hyperon decay amplitudes transform according to the regular representation of SU_6, one obtains, in addition to the relations following from $\Delta T = \frac{1}{2}$, two more independent relations among the observed amplitudes. One of the two relations was already derived by Gell-Mann as a consequence of the octet hypothesis under SU_3 together with CP invariance. When CP invariance is used in addition to the assumption on the SU_6 behavior of the amplitudes, a further independent relation that the hyperon decay amplitudes are all expressed in terms of a single parameter is obtained. (C.E.S.)

10079 METHOD OF ORTHOGONALITY CONSTRAINT AND REARRANGEMENT COLLISIONS. A. Chen, S. Tani, and S. Borowitz (New York Univ., New York). Phys. Rev., 137: B236-44(Jan. 25, 1965).

In treating scattering problems involving a bound state, the method orthogonality constraint modifies the potential by projecting out the binding effect of the potential strong enough to support a bound state and considers only its scattering effect as the perturbation on a distorted wave which is orthogonal to the bound state. The modified Born series obtained by iterating the relevant Lippmann-Schwinger integral equation is proved to be convergent, provided resonances not associated with the bound state are absent. The convergence proof is given for one-dimensional even waves and for a separable potential. However, the proof is also valid for the s waves. On the basis of a simplified analysis, it is believed that the method will work for a wide class of physically interesting potentials, though a rigorous proof for it is not available. The convergence of the Born expansion for rearrangement collisions is discussed in the context of a one-dimensional model for a three-body problem in which exchange scattering takes place. It is seen in the example that the kind of divergence pointed out by Aaron, Amado, and Lee may be removed by this method. (auth)

10080 Λ-NUCLEON INTERACTION FROM ANALYSIS OF S-SHELL HYPERNUCLEI. R. C. Herndon (Univ. of California, Livermore), Y. C. Tang, and E. W. Schmid. Phys. Rev., 137: B294-300(Jan. 25, 1965). (UCRL-12037)

From the binding-energy data of the S-shell hypernuclei, the triplet and singlet depths of a central Λ-nucleon potential, which has a hard core of radius 0.4 F and an attractive well of exponential shape with a range suggested by the mechanism of two-pion exchange, are determined. The results show that the singlet interaction is stronger than the triplet interaction. The well-depth parameters are equal to 0.865 and 0.675, indicating that the strength of the Λ-nucleon potential is not sufficient to bind a hyperdeuteron, although it is sufficient to allow the existence of a bound excited state in the hypernuclei $_\Lambda H^4$ and $_\Lambda He^4$ with a binding energy B_Λ in the neighborhood of 0.35 Mev. The binding energy of a Λ particle in nuclear matter and the Λ-nucleon scattering cross sections were computed from the Λ-nucleon interaction found in the analysis. In both cases, fair agreement with experimental results was obtained. (auth)

10081 NEUTRON-DEUTERON SCATTERING AT LOW ENERGIES. V S. Bhasin (Univ. of Delhi), G. L. Schrenk, and A. N. Mitra. Phys. Rev., 137: B398-401(Jan. 25, 1965).

The scattering lengths and low-energy phase shifts in n-d scattering are evaluated, using a previously formulated exact three-body formalism with separable potentials. The nature of the contribution of the potential scattering to the scattering lengths is examined within this formalism and found not to exceed 10% of the nucleon-exchange contribution. (auth)

10082 ARTIFICIAL SINGULARITY IN THE MULTICHANNEL ND^{-1} EQUATIONS OF THE NEW STRIP APPROXIMATION. Shu-yuan Chu (Univ. of California, Berkeley). Phys. Rev., 137: B409-10(Jan. 25, 1965).

It is shown that the Wiener-Hopf technique introduced by Chew in the single-channel case to remove the artificial singularity near the strip boundary can be applied straightforwardly to the multichannel case. The singular ND^{-1} equations are reduced to a system of Fredholm equations which can be solved directly by numerical methods. No new Wiener-Hopf operators arise. (auth)

10083 SOME CONSIDERATIONS ON NONLEPTONIC DECAYS. H. T. Nieh (Harvard Univ., Cambridge, Mass.). Phys. Rev., 137: B411-14(Jan. 25, 1965).

A mechanism, based on the hypothesis that there is a direct interaction of the mesons with the charged vector field Z_μ, was proposed by Schwinger for the pure $\Delta T = 3/2$ decay $K^+ \rightarrow \pi^+ + \pi^0$. An extension of this mechanism to other predominantly $\Delta T = 1/2$ nonleptonic decays is considered. The three branching ratios $\Gamma(K_1^0 \rightarrow \pi^+\pi^-)/\Gamma(K_1^0 \rightarrow \pi^0\pi^0)$, $\Gamma(\Lambda \rightarrow p\pi^-)/\Gamma(\Lambda \rightarrow n\pi^0)$, and $\Gamma(\Xi^- \rightarrow \Lambda\pi^-)/\Gamma(\Xi^0 \rightarrow \Lambda\pi^0)$ are seen to be closely related. The isotopic-spin change is seen to be $\Delta T = 1/2$ for all 3π modes of the K-meson decays. Relations are derived among the parameters describing the energy spectra of $K_{\pi 3}$ decays. (auth)

10084 STRANGE-PARTICLE PRODUCTION BY 3-Bev/c π^- MESONS IN HYDROGEN. T. P. Wangler, A. R. Erwin, and W. D. Walker (Univ. of Wisconsin, Madison). Phys. Rev., 137: B414-22(Jan. 25, 1965). (COO-881-41)

Over 600 strange-particle events were identified on the basis of both kinematical fitting and bubble-density information. The center-of-mass angular distributions generally show the familiar backward tendency for the baryons and forward tendency for the K mesons. Invariant mass distributions show the production of several resonant states including the Y_1^*(1385 Mev), K^*(885 Mev), and Y_0^*(1405 Mev). The two-body reactions $\pi^- + p \rightarrow K^* + Y_1^*$ and $\pi^- + p \rightarrow K^* + Y_0^*$ are also reported and studied. The two-, three-, and four-particle reactions are discussed and an attempt is made to put limits on the SU_3 multiplet of the f^0 from the number of $K_1^0K_1^0$ events with a mass near the f^0. The cross sections are calculated, and the total strange-particle cross section at this energy is estimated to be $\sigma = (1.68 \pm 0.20)$ mb. (auth)

10085 REMARK ON THE BALÁZS-TYPE BOOTSTRAPS. M. L. Mehta and P. K. Srivastava (Univ. of Delhi). Phys. Rev., 137: B423-5(Jan. 25, 1965).

The dependence of the Balázs-type bootstrap calculations on the subtraction as well as the matching point is numerically checked for two typical examples, the ρ parameters and the deuteron pole parameters. In the case of the ρ parameters, the results are very sensitive to the choice of the matching point. The matching point was varied from $s = 0$ to $s = -8m_\pi^2$. In this range m_ρ^2 varied from ~10 to $\sim 32m_\pi^2$. The input and output widths were equal only when the matching point was between $s = 0$ and $s = -1.6m_\pi^2$. In this region m_ρ^2 is a very sensitive function of the matching point. The results are almost independent of the subtraction point. In the calculation of the deuteron parameters, there exists no self-consistent solution in the expected region. (auth)

10086 ANGULAR CORRELATIONS IN K_{e4} DECAYS AND DETERMINATION OF LOW-ENERGY π-π PHASE SHIFTS. Nicola Cabibbo and Alexander Maksymowicz (Univ. of California, Berkeley). Phys. Rev., 137: B438-43(Jan. 25, 1965). (UCRL-11590)

The study of correlations in K_{e4} decays can give unique information on low-energy π-π scattering. A simple set of correlations is introduced. It is shown that the measurement of these correlations at any fixed π-π c.m. energy allows one to make a model-independent determination of the difference δ_0-δ_1 between the S- and P-wave π-π phase shifts at that energy. Information about the average value of δ_0-δ_1 can be obtained from a measurement of the same correlations averaged over the energy spectrum. Measurement of the average correlations is particularly suited to the testing of any model of low-energy π-π scattering. The Chew-Mandelstam effective-range description of S-wave scattering and the Brown-Faier σ-resonance model for the S wave are discussed. If the Chew-Mandelstam description is adequate, the suggested measurements should yield a value for the S-wave scattering length in the I = 0 state. If the σ-resonance model is correct, these measurements should yield a value for the mass of the resonance. (auth)

10087 LEPTONIC DECAY OF THE Ω. Jon Mathews (California Inst. of Tech., Pasadena). Phys. Rev., 137: B444-8(Jan. 25, 1965).

The decay $\Omega \rightarrow \Xi^0$ + lepton + $\bar{\nu}$ is considered. The vector rate may be estimated with the aid of unitary symmetry and the generalized conserved-vector-current hypothesis of Cabibbo. Rates of 1.07×10^7 sec^{-1} and 0.70×10^7 sec^{-1} are obtained for electronic and muonic decay, respectively. A Goldberger-Treiman relation may be written down for the axial-vector matrix elements, but there does not appear to be enough information to estimate the axial-vector decay rates. (auth)

10088 HIGH-ENERGY ELASTIC SCATTERING AT LARGE ANGLES AND THE STATISTICAL MODEL. Ching-hung Woo (Stanford Univ., Calif.). Phys. Rev., 137: B449-51(Jan. 25, 1965). (SLAC-PUB-42)

High-energy elastic p-p scattering data show, in addition to the forward peak, a large-angle component which is not inconsistent with isotropy in angular distribution but which decreases very rapidly with energy. It was proposed that both the precipitous drop with energy and the angular dependence support a statistical model for large-angle scatterings. While it is known that the statistical model actually does not predict isotropy in angular distribution, it is argued that under plausible assumptions the precipitous drop with energy is also not a feature of the statistical model. Hence the present data should not be interpreted as strong indications of the presence of a statistical component in high-energy collisions. (auth)

10089 TEMPERATURE DEPENDENCE OF POSITRON MEAN LIVES IN POLYMERS. B. C. Groseclose and G. D. Loper (Oklahoma State Univ., Stillwater). Phys. Rev., 137: A939-41(Feb. 1, 1965).

The mean lives and intensities of positrons decaying by the pickoff mechanism in polystyrene, Lucite, and polyethylene (Marlex 50) were measured in the temperature interval −200 to +150°C. The mean-life variation with temperature in both polystyrene and Lucite has the same general shape as the specific-volume variation of these materials and may be interpreted as a free-volume effect. However, an observed sharp drop of τ_2 with decreasing temperature below −20°C in Marlex 50 does not correspond to the smooth change in volume of this material in that temperature range. (auth)

10090 MOUNTAIN-ALTITUDE QUEST FOR FRACTIONALLY CHARGED PARTICLES. T. Bowen, D. A. DeLise, R. M. Kalbach, and L. B. Mortara (Univ. of Arizona, Tucson). Phys. Rev. Letters, 13: 728-31(Dec. 14, 1964).

A five-element coincidence-anticoincidence scintillation telescope is used at mountain altitudes to search for particles having $0.025 < dE/dx < 0.7$ (in units of $(dE/dx)_{\min}$ for charge e). A comparison of the experimental pulse-height spectra with those expected from the charge-e/3 "quarks" indicates that the lower limits on the masses of the quarks is 16 or 17 Bev/c^2, depending on whether the production cross section for these particles above threshold in cosmic radiation is 0.1 or 0.01 mb respectively. An effective quark-removal cross section of 15 mb is also assumed in the mass calculations. (T.F.H.)

10091 ELECTROMAGNETIC MASS CORRECTIONS IN THE SU(6) SYMMETRY. C. H. Chan and A. Q. Sarker (Univ. of California, San Diego, La Jolla). Phys. Rev. Letters, 13: 731-3(Dec. 14, 1964).

A set of mass relations is obtained between the members of various isomultiplets, in the limit in which the SU(6) symmetry is broken by electromagnetism only. Since SU(6) contains both the octet and decuplet in its 56-dimensional representation, it is expected that the assumption of SU(6) symmetry should relate the electromagnetic mass splittings of the octet and decuplet, and might put further restrictions on the mass relations. (T.F.H.)

10092 VECTOR-MESON MODEL FOR BARYON LEPTONIC DECAYS. Barbara Barrett and Tran N. Truong (Columbia Univ., New York). Phys. Rev. Letters, 13: 734-7(Dec. 14, 1964).

Relations governing the leptonic decay of baryons are derived, assuming that vector and tensor meson poles dominate the dispersion relations. It is postulated that ρ and K* vector mesons are dominant. In the relations for hyperon decays, the strong-coupling constants derived from unitary symmetry are used. (T.F.H.)

10093 ON ONE OF SELECTION CRITERIA OF pp-INTERACTIONS IN NUCLEAR EMULSIONS. B. P. Bannik, T. Vishki, and Ying-seb To (Joint Inst. for Nuclear Research, [Dubna, USSR]). Pribory i Tekhn. Eksperim., No. 5, 70-2(Sept.-Oct. 1964). (In Russian)

Particle cluster distributions were measured according to the magnitudes of stars in nuclear emulsion. Comparisons with the distribution of clusters produced by δ-electron formation and incidental pile-up of background granules showed that the clusters are related to the recoil nuclei. Recoil nuclei can be partially separated from the incidental superimposition. (tr-auth)

10094 THE TRANSPORT EQUATION WITH PLANE SYMMETRY AND ISOTROPIC SCATTERING. M. G. Smith (Sir John Cass Coll., London). Proc. Cambridge Phil. Soc., 60: 909-21(Oct. 1964).

The double integral equation, which takes the place of the Milne equation in the one-dimensional problem, is derived from the governing partial differentio-integral equations. An analytical solution of the problem of a distribution of point sources on a plane, when the other boundaries are at infinity, is found. The possibility of more complicated boundary conditions is discussed. (auth)

10095 NON-LINEAR INTERACTIONS, CAUSALITY AND THE R-MATRIX. E. A. Power and I. Saavedra (London Univ. and Univ. of Chile, Santiago). Proc. Cambridge Phil. Soc., 60: 935-8(Oct. 1964).

The problem of causality in nonrelativistic scattering where a bounded region of nonlinear interaction occurs is re-examined in the context of a model proposed by Ebel. It is shown that the acausal behavior in the model can not be accounted for in the straightforward manner that is possible for an energy-dependent but linear potential which gives rise to a similar R-matrix. (auth)

10096 X-RAY SPECTRAL MEASUREMENTS ON HIGH VOLTAGE AND SUPERVOLTAGE THERAPY BEAMS. Paul N. Goodwin and Chet Opal (John Hopkins Medical Institutions, Baltimore). Radiology, 84: 127(Jan. 1965).

The spectral distributions of radiation in actual treatment beams were measured for 200 to 250 kv x rays, 2 Mv x rays, and ^{60}Co gamma rays to study the effects of wedge filters and collimating devices on therapy beams and to obtain more accurate information for the determination of Roentgen-to-Rad conversion factors. The measurements were made by using a scintillation counter to determine the radiation scattered by a thin sheet of low-atomic number material placed in the beam at the normal SSD. Measurement of the once-scattered spectrum offers considerable advantages over direct measurement in the high-voltage region, since x-ray generators may be operated at normal tube currents, clinical beam collimators may be used, pin-hole alignment is no longer a problem, and scatter effects in the crystal collimator are greatly reduced. (P.C.H.)

10097 THE PHOTOPRODUCTION OF π MESONS NEAR THRESHOLD. A. M. Baldin. Tr. Fiz. Inst., Akad. Nauk SSSR, 19: 3-36(1963). (In Russian)

The history of experimental and theoretical attempts to understand the photoproduction of π mesons is reviewed. Perturbation theory was found insufficient to account for the cross section for the $p(\gamma,n)\pi^+$ cross sections in the threshold region where the reduced momentum of the meson $\eta < 1$. Dispersion equations which result from the basic postulates of relativistic field theory are presented and discussed. These equations cannot be compared directly with experiments because of the difficulties involved in evaluating the imaginary terms in the dispersion integral. For $\eta < 1$ the numerical solution of the dispersion integral is in good agreement with experimental $p(\gamma,\pi)$ data. Discrepancies in experimental and theoretical cross sections for π mesons emitted at angles $\theta = 0$ and 180° with respect to the incident γ rays are of interest, since the equations for the cross sections are greatly simplified at these angles. Pion-neutron interactions can only be studied indirectly in multi-nucleon nuclei. The cross section for such reactions is usually treated as the sum of the cross sections for the free nucleons (momentum approximation). A quadratic correction term is derived for the pion-nucleus reaction which accounts for the interaction of the nucleons in the nucleus; this term is especially important at large θ. The simplest nucleus for the study of pion-neutron interactions is the deuteron. Equations are given for the $d(\gamma,d)\pi^0$, $d(\gamma,2n)\pi^+$, and $d(\gamma,2p)\pi^-$ reactions. For the $d(\gamma,2n)\pi^-$ the coulomb forces, proportional to $1/v$, must be considered for $\eta < 1$. Theoretical and experimental cross sections for the $d(\gamma,2p)\pi^-$ reaction are compared in detail. (TTT)

10098 EXPERIMENTAL STUDY OF THE PHOTOPRODUCTION OF NEGATIVE PIONS FROM DEUTERIUM NEAR THE THRESHOLD. M. I. Adamovich, V. G. Larionova, and S. P. Kharlamov. Tr. Fiz. Inst., Akad. Nauk SSSR, 19: 37-65(1963). (In Russian)

The $d(\gamma,2p)\pi^-$ and $d(\gamma,2n)\pi^+$ reactions were studied near the pion threshold energy. Type P, NIKFT emulsions were soaked in heavy water and then irradiated in a collimated synchrotron photon beam. A magnet removed photoproduced charged particles from the beam. An ionization chamber was used to measure photon flux. Charged-particle energies (<30 Mev) were determined from the path lengths and/or grain densities in the emulsions. The $d(\gamma,2p)\pi^-$ reactions were identified by comparing the momenta and energies of the particles with conservation laws. A total of 1050 reactions was observed for photon energies of 150 to 200 Mev. In this range the $d(\gamma,2p)\pi^-$ cross section varied from 0 to 1.2×10^{-28} cm^2. For photon energies under 174 Mev the $d(\gamma,2p)\pi^-$ reaction proceeds by an electric-dipole absorption of the photon, leading to an S-state pion and $1S_0$-state protons. The data compare favorably with those of other experimenters and with calculations based on the impulse approximation. (TTT)

10099 PARTICLES OF HALF-INTEGRAL SPIN IN UNIVERSAL SIX-DIMENSIONAL SPACE. Yu. A. Rylov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 3-14(May-June 1964). (In Russian)

The spinor field in the universal six-dimensional space was studied. It was found that all elementary particles may be considered as various states of the field. Transformation of the six-dimensional charge conjugation and the particle-antiparticle transformation were also investigated. (tr-auth)

10100 1962 CARGÈSE LECTURES IN THEORETICAL PHYSICS. Notes from the French Summer School for Theoretical Physics, Cargèse, Corsica, July 1962. Maurice Lévy, ed. New York, W. A. Benjamin, Inc., 1963. 443p. $13.00 (cloth edition); $8.95 (paperback).

Eleven lectures are presented on the many-body problem and elementary particle physics. Separate abstracts were prepared for ten. One lecture was abstracted previously in NSA; see 16: 24731. (L.B.S.)

For abstracts of individual lectures see: 10101, 10102, 10152, 10153, 10154, 10155, 10156, 10157, 10213, and 10374.

10101 LEPTONS. Jeremy Bernstein. p.VIII1-35 of "1962 Cargèse Lectures in Theoretical Physics." New York, W. A. Benjamin, Inc., 1963.

The arguments that led to the belief that two different neutrinos exist are considered. The local theory, nonlocality, and the problem of nonlocality are discussed. (L.B.S.)

10102 HIGH-ENERGY NEUTRINO-INDUCED REACTIONS. G. Charpak and M. Gourdin. p.IX1-33 of "1962 Cargèse Lectures in Theoretical Physics." New York, W. A. Benjamin, Inc., 1963.

The behavior of the cross sections for weak processes at very high energy was analyzed. It is shown that the Fermi theory cannot be applied at very high energies because of the violation of unitarity. The general structure of the cross section in the Fermi theory, fundamental length, forbidden processes, modifications to the Fermi theory, generalities on the intermediate boson theory, and production of the intermediate boson W are discussed. Elastic, inelastic, strange-particle elastic production, and hyperons and K mesons inelastic production reactions with neutrinos and antineutrons are listed; and the general structure of the cross sections for these reactions are considered. Some problems that may be resolved by high-energy neutrino experiments are listed, and experiments with high-energy neutrinos from accelerators are discussed. (L.B.S.)

10103 REGGE POLES IN THE STRIP APPROXIMATION. Donald Alfred Jacobson. Thesis, Berkeley, Calif., Univ. of California, 1964. 98p.

Using the strip approximation to the Mandelstam representation as a basis, a model is developed for self-consistently calculating Regge trajectories and residues. The model is illustrated for both boson and fermion Regge poles and is generalized to include several channels. An approximation scheme is proposed, which allows the Regge pole parameters to be calculated in a systematic way, and the lowest order approximation, called the "mass shell approximation," is used to obtain numerical results. In the nonrelativistic limit, the mass shell approximation is used to prove some general properties (asymptotic behavior, threshold behavior, etc.) of the leading trajectory for single attractive Yukawa potentials, which turn out to be exact in spite of the approximation. Furthermore, the calculated trajectories agree surprisingly well with the exact trajectories for a wide range of potential strengths. Finally, a parameter-free self-consistent calculation of the rho-trajectory was carried out, the resultant rho-resonance having a mass of 408 Mev, and a width of 116 Mev. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10104 NUCLEON-ANTINUCLEON ANNIHILATION INTO PIONS AND HEAVY NON-STRANGE BOSONS. Gabriel Pinski. Thesis, Rochester, N. Y., Univ. of Rochester, 1964. 124p.

The role of pion resonances in nucleon-antinucleon annihilation is studied. The statistical model is modified to include resonant interactions, and integrals arising in the modified model are reduced to either products of phase space factors or simple integrals over such products. The calculation of isospin weights is explained and weights are tabulated for all charge complexions resulting from annihilation into states decaying into not more than eight pions. Single production and associated production of ρ and ω resonances are included. In addition to the usual statistical model scaling factor, a parameter is introduced for each resonance, which is incorporated into the model. An interpretation of these parameters is given. The parameters are fixed by the experimental results for ρ and ω production in the reaction $\bar{p} + p \rightarrow 2\pi^+ + 2\pi^- + \pi^0$ and for the average multiplicity, at incident antiproton momentum 1.61 Bev/c. Using these values for the parameters, predictions of the model for multiplicities and for the relative percentages of ρ and ω production in other reactions are presented. The question of associated production of pion resonances is also considered. The calculation of mass distributions is explained and results are given for the reaction $\bar{p} + p \rightarrow 2\pi^+ + 2\pi^- + \pi^0$. A possible explanation for the apparent absence of the η resonance in this reaction is presented. Selection rules for annihilation into pions, and symmetry properties of pion systems are reviewed and their role in constructing transition matrix elements is demonstrated. The procedure for construction of matrix elements for annihilation to final states containing a ρ or ω is outlined and examples are given. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10105 THE REACTION $\pi^- + P \rightarrow \pi + \pi +$ NUCLEON AT 3 Bev/C. Vasken Hagopian. Thesis, Philadelphia, Univ. of Pennsylvania, 1964. 76p.

The Brookhaven National Laboratory 20-inch liquid hydrogen bubble chamber was exposed to a 3-Bev/c separated π^- beam at the Alternating Gradient Synchrotron. In a total π^- path length of 1.5×10^7 cm in liquid hydrogen, a study among the events with two charged-particle final states, yielded 417 events of the type $\pi^- + P \rightarrow \pi^- + \pi^0 + P$ and 723 events of the type $\pi^- + P \rightarrow \pi^- + \pi^+ + N$. Very little isobar formation was detected. The f^0 resonance was observed for the first time in this experiment. It has a mass of 1250 Mev, isotopic spin T = 0, parity even, G-parity even and spin of two or greater. The other observed π-π resonance, the ρ meson, was interpreted in terms of π-π scattering at resonance. The angular distribution of the ρ meson corresponds to a P-wave going through 90°. In addition to the P-wave at masses in the vicinity of the ρ, the π-π interaction has a T = 2 S-wave of about −14° ± 8°. In the vicinity of the neutral mode of the ρ, the π-π interaction has in addition a large amount of T = 0 S-wave of about 90° ± 30° and a T = 0 D-wave of magnitude less than 25°. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10106 PROTON PROTON ELASTIC SCATTERING AT LARGE MOMENTUM TRANSFERS. Alan David Krisch. Thesis, Ithaca, N. Y., Cornell Univ., 1964. 53p.

Twenty-nine, differential cross sections for proton-proton elastic scattering were measured at momentum transfer of $-t = 2.3\ (\text{Bev/c})^2$ to $-t = 24.4\ (\text{Bev/c})^2$ and kinetic energies of 10 to 31 Bev. The quantity t is defined as $-t = 2p^2\,(1 - \cos^2\theta)$ in the center of mass. The experimental method consisted of scattering the protons in the internal beam of the AGS by a polyethylene target. Both the scattered and recoil protons were analyzed with respect to angle and momentum by collimators and bending magnets. The particles were detected by scintillation counter telescopes in coincidence. Resolving times of 10^{-9} seconds and a long duty cycle eliminate most accidental background. Tight angular and momentum resolution eliminate inelastic and quasielastic background. Cross sections as low as 8×10^{-37} cm²/steradian were measured. Counting rates varied from 100 per second to 1 per hour. Results show that the energy dependence or "shrinkage" becomes more pronounced at high momentum transfer; the ratio of the cross sections at 10 and 30 Bev is 10^3 at $-t = 10\ (\text{Bev/c})^2$. For $\theta_{\text{cm}} > 65°$ the center of mass differential scattering cross section seems to be fairly constant. When the normalized differential scattering cross section is plotted against $\tau = p^2\sin^2\theta$ much of the energy dependence is removed. There is also a sharp break in the curve. This break has been interpreted as evidence for the existence of a core. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10107 PROTON DISINTEGRATION OF THE DEUTERON. Richard Frederick Carlson. Thesis, Minneapolis, Univ. of Minnesota, 1964. 62p.

The reaction $p + d \rightarrow p + p + n$ was studied with the object of determining, by the method of Chew and Low (Phys. Rev. 113: 1640(1959)) the cross section for the elastic scattering reaction $p + n \rightarrow p + n$. Since the latter cross section is known, the present experiment can serve as a test of the Chew-Low theory. The essential physical principle employed by Chew and Low relates to the locations and residues of poles in the scattering matrix, a connection existing between the residues and certain physically measurable quantities. The center of mass differential proton-neutron cross section at the center of mass energy 9.72 Mev and center of mass angle 90° was found, using the experimental data plus the Chew-Low method, to be 36.5 ± 3 mb/sterad. This is to be compared with the known differential neutron-proton cross section, at the same angle and energy, of 38.2 ± 3 mb/sterad. Therefore, it appears that the Chew-Low method is valid, if the present experiment is a true test of the hypothesis. (A.G.W.)

10108 INTERACTIONS OF 17 Gev/c NEGATIVE PIONS. Frederick Russell Huson. Thesis, Berkeley, Calif., Univ. of California, 1964. 61p.

An analysis of 10,000 bubble chamber photographs is presented. The photographs were taken in the one-meter École Polytechnique heavy liquid chamber with a mixture of one-half propane (C_3H_8) and one-half freon (CF_3Br) by volume. This mixture plus the fiducial volume used gave a 98.6 percent probability of observing at least one of the two electron pairs produced by the photons from neutral pion decay. Forty-eight pion-neutron and 134 pion-proton events were analyzed assuming a two-vertex interaction model. The pion vertex contained the particles going forward in the center of mass and the nucleon vertex contained the particles going backward. For the inelastic pion-nucleon interactions, G parity at the pion vertex gives an upper limit of 45 percent for one-pion exchange. The Δ_δ (3/2,3/2,1238) resonance was produced at the nucleon vertex in about 50 percent of these interactions. A small peak was found in the three-pion mass distributions at 1350 Mev, but statistics were too poor to determine its significance. The total cross section for the diffraction dissociation of one pion into three pions was $\lesssim 8$ mb per carbon or fluorine nucleus. The ratio of the $2\pi^- + \pi^+$ mode to the $2\pi^0 + \bar{\pi}$ mode was 1.7 ± .4. Seventy-five percent of these two final states contained a pion and a rho meson. A cross section of $\lesssim 1$ mb was found for diffraction dissociation of one pion into five pions. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10109 CONSTRUCTION OF INVARIANT SCALAR AMPLITUDES WITHOUT KINEMATICAL SINGULARITIES FOR ARBITRARY-SPIN NON-ZERO MASS TWO-BODY SCATTERING PROCESSES. David Noel Williams. Thesis, Berkeley, Calif., Univ. of California, 1964. 99p.

The relativistic transition amplitude for any two-body reaction involving only particles of nonzero mass but arbitrary spin is decomposed in terms of scalar amplitudes that are regular functions in the space of scalar invariants at points corresponding to regular points of the transition matrix elements in momentum space, on the mass shell. Detailed formulas for the scalar amplitudes in terms of the original scattering matrix elements are given. The development is in the framework of analytic S-matrix theory, and is based on a partial generalization of the Hall-Wightman theorem. The results hold on the complete (multisheeted) domain of regularity of the scattering amplitude. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10110 A NUMERICAL STUDY OF THE REGGE PARAMETERS IN POTENTIAL SCATTERING. Akbar Ahmadzadeh. Thesis, Berkeley, Calif., Univ. of California, 1964. 155p.

The threshold and asymptotic behavior of the Regge parameters are discussed and some examples given. It is shown that the position and residue of the first trajectory of a single attractive Yukawa potential satisfy the dispersion relation expected when there are no intersections with other trajectories. An example is given of a repulsive Yukawa potential where the position of the pole does not satisfy such a dispersion relation. The Regge parameters for the first few trajectories of a single attractive Yukawa potential are given in the form of figures. Examples are given of a simple superposition of attractive and repulsive Yukawa potentials for which the trajectories are similar to the relativistic case. By modifying the background integral, the Regge formula is rewritten to include the Born term and to make the background integral less significant. The Khuri series for the partial-wave amplitude is modified to explicitly single out the Born term. The convergence of this series is investigated for the case of a single Yukawa potential. It is found that the modified series converges considerably faster than the Khuri series. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10111 LOW-ENERGY NEGATIVE PION INTERACTIONS IN DEUTERIUM. William Charles Bowman. Thesis, Berkeley, Calif., Univ. of California, 1964. 82p.

An attempt is made to resolve the discrepancy between the measured deuterium ratio, $S = [\omega(\pi^- + d \rightarrow n + n)/\omega(\pi^- + d \rightarrow n + n + \gamma)]$, and values predicated from the s-wave pion relations and the theoretically calculated ratio $T = [\omega(\pi^- + d \rightarrow n + n + \gamma)/\omega(\pi^- + p \rightarrow n + \gamma)]$. The cross sections $\sigma(\pi^- + d \rightarrow n + n + \gamma) = (3.78 \pm 0.79) \times 10^{-29}$ cm²/sterad, $\sigma(\pi^- + d \rightarrow n + n) = (3.67 \pm 0.45) \times 10^{-28}$ cm²/sterad, and $\sigma(\pi^- + d \rightarrow \pi^0 + n + n) = (7.84 \pm 0.57) \times 10^{-28}$ cm²/sterad were measured at 90° in the center-of-mass system for 51-Mev incident pion energy. The radiative absorption cross section and the s-wave pion relations indicate the value of T = 0.91 ± 0.19, in agreement with theoretical calculations. The calculation of S = 1.51 ± 0.40 from the cross section measurements and the value S = 1.92 ± 0.33 measured by direction detection of both reactions is in agreement with the value S = 1.74 ± 0.28 calculated from the s-wave pion relations. An indirect measurement comparing radiative captures in hydrogen and deuterium gave a value of S = 3.37 ± 0.46, in relative agreement with other indirect measurements. This discrepancy appears to be due to difficulty in monitoring the number of pions captured in hydrogen and deuterium. A total-absorption plastic scintillation counter was used for all measurements. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10112 REGGE POLES AND S-MATRIX THEORY. Steven C. Frautschi. Frontiers in Physics. A Lecture Note and Reprint Series. New York, W. A. Benjamin, Inc., 1963. 205p. $8.00 (cloth edition); $3.95 (paperback).

A theoretical approach to the problem of strongly interacting particles is outlined. Effective range theory of s-wave scattering, the N/D method, the ambiguity of Castillejo, Dalitz, and Dyson, and Levinson's theorem, the Mandelstam representation for nonrelativistic potential scattering, Mandelstam representation for relativistic scattering, the generalized potential, polology and nearby cuts, the strip approximation, asymptotic behavior of amplitudes, Regge poles in nonrelativistic scattering, Regge poles of the Coulomb scattering amplitude, Regge poles in relativistic scattering, composite particles, the Khuri-Jones threshold factor, and the possibility of Regge cuts are discussed. (C.E.S.)

10113 RECENT RESULTS OBTAINED AT SACLAY. PART I. NUCLEAR POLARIZATION. J. Combrisson (Centre d'Etudes de Nucleaires, Saclay, France). p.16-29 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964. (In French)

The importance of polarized nuclei targets for low- and high-energy nuclear physics is discussed along with the techniques used to obtain polarized proton and deuteron beams for particle accelerators. Two main practical aspects of polarized targets are: reconciling requirements of those who want no wall between their beam and the target and those of the physicists who need their samples in a resonant cavity at helium temperature; and accurate measurements of the polarization of the protons of a target. The theoretical aspect involves calculation of the degree of polarization as a function of magnetic field, temperature, and sample characteristics. Future trends in this field are briefly mentioned. (auth)

10114 NUCLEAR RELAXATION OF PROTONS AND DEUTERONS IN PARAMAGNETIC SOLUTIONS. A. Arth and F. Noack (Technische Hochschule, Stuttgart). p.344-6 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964. (In French)

Nuclear magnetic relaxation times for protons and deuterons in aqueous $Cr(NO_3)_3$ solutions were measured in the frequency range of 0.1 to 160 Mc/s. The frequency dependence of T_1 and T_2 could be satisfactorily explained by the theory of Solomon and Bloembergen by taking into account the influence of the electronic Cr^{3+} relaxation and both dipolar and scalar interaction between the nuclear and electronic spins. (auth)

Field Theory and Quantum Mechanics

10115 FUNCTIONAL CALCULATION FOR FERMI FIELDS. H. D. Clausen and P. Urban (Universität, Graz). Acta Phys. Austriaca, 19: 45-52(1964). (In German)

It is shown that the functional calculation given by Lehmann-Symanzik-Zimmermann for Bose fields is also applicable to Fermi fields in the calculation of T and R products. (tr-auth)

10116 EXPONENTIAL ORDER OF THE VACUUM S-MATRIX IN REGULARIZED FIELD THEORIES. William M. Frank (Naval Ordnance Lab., Silver Spring, Md.). Ann. Phys. (N. Y.), 30: 328-47(Nov. 1964).

The exponential order in z is determined for the augmented blind vacuum S-matrix in regularized field theories. For theories with positive type fermion propagator this order is exactly $(\frac{1}{2}t - 1)^{-1}$ where the fermion propagator has a large momentum behavior $|k|^{-t}$. For fermion propagators of nonpositive type the order is no greater than and most likely equal to $(\frac{1}{2}t - 1)^{-1}$. The implication of these results is discussed. (auth)

10117 NOTE ON A MODIFIED BORN APPROXIMATION FOR SCATTERING AMPLITUDES. B. O. Enflo and J. C. Parikh (Univ. of Stockholm and Universitet, Copenhagen). Arkiv Fysik, 28: 45-7(1964).

It is shown for a scattering amplitude, by means of unitarity and dispersion theory, how a modified Born approximation, with a vertex function instead of coupling constants, can be deduced by taking part of the cuts in the amplitude into account. (auth)

10118 NUMERICAL EVALUATION OF QUANTUM EFFECTS ON TRANSPORT CROSS SECTIONS. S. Imam-Rahajoe, C. F. Curtiss, and R. B. Bernstein (Univ. of Wisconsin, Madison). J. Chem. Phys., 42: 530-6(Jan. 15, 1965).

Quantum-mechanical calculations of the transport cross sections $Q^{(1)*}$ and $Q^{(2)*}$ and the associated $\Omega^{(n,t)*}$ integrals for a Lennard-Jones (12, 6) potential are discussed. The computations were made for three values of the quantum parameter Λ^* (= 1, 2, 3), and include the effect of statistics. The quantum effects became quite important at reduced temperatures T^* below about unity. The quantum corrections to the integrals were negative at moderate temperatures, but became positive at higher temperatures. (auth)

10119 NEW LATTICE MODEL FOR THE STATISTICAL MECHANICS OF QUANTUM FLUIDS. I. LIQUID HYDROGEN AND ITS ISOTOPES. Sidney W. Benson and Raymond P. Marchi (Stanford Research Inst., Menlo Park, Calif.). J. Chem. Phys., 42: 574-8(Jan. 15, 1965).

A lattice-cell model for quantum fluids is proposed in which the thermal energy of the lattice is represented by the Debye equation for crystalline solids. The maximum Debye frequency ν_D is taken equal to the simulated frequency for a single hard-sphere molecule moving in an infinitely deep, cubic potential well. Lennard-Jones parameters from viscosity measurements on H_2 are used to describe the van der Waals lattice energy. The only parameter in the theory is the equivalent hard-sphere diameter. This is determined from the molar volume of liquid H_2 and is 2.79 Å, very close to the Lennard-Jones value of σ, 2.92 Å. Calculated values of the molar volumes of D_2, T_2, and the intermediate HD are in good agreement with observed values, as are the heats of vaporization and specific heats. Calculated values of the coefficients of compressibility and thermal expansion are too low, but the value of internal pressure $(\partial P/\partial T)_v$ is in excellent agreement with observed values. The model yields, for the first time, a lower free energy for the body-centered lattice than for the face-centered lattice. This reflects the importance of the increased free volume and hence lower zero-point energy for the less compact lattices. The actual differences in free energy for different packings are small compared to RT near the boiling points and this suggests very large fluctuation in packing in the liquids. The relation to melting is discussed briefly. Calculations show that the isotopic properties are very sensitive to the form of the repulsive potential. (auth)

10120 GAUSSIAN ONE- AND TWO-ELECTRON WAVEFUNCTIONS. J. V. L. Longstaff and K. Singer (Royal Holloway Coll., Surrey, Eng.). J. Chem. Phys., 42: 801-2 (Jan. 15, 1965).

The convergence of certain types of linear combinations of Gaussian functions to the exact ground-state wavefunctions of H and H_2, respectively, is illustrated. (M.C.G.)

10121 SPHERICALLY SYMMETRIC GRAVITATIONAL FIELDS. P. G. Bergmann, M. Cahen, and A. B. Komar (Yeshiva Univ., New York). J. Math. Phys. (N. Y.), 6: 1-5 (Jan. 1965).

It is shown that the Schwarzschild solution is the only spherically symmetric solution of the Einstein vacuum field equations, even when the differentiability of the metric is weakened to the extent of permitting solutions which are C^0, piecewise C^1. Petrov's purported counterexample is analyzed and shown to be essentially equivalent to Schwarzschild's example. (auth)

10122 CLUSTER PROPERTIES OF MULTIPARTICLE SYSTEMS. W. Hunziker (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 6: 6-10(Jan. 1965).

A system of N particles in nonrelativistic quantum mechanics is investigated. The particles interact via two- or many-body potentials, for which a sufficient condition is that they be square integrable in the relative coordinates of the interacting particles. Cluster properties are derived for the time translation operator, for the wave operators, for the transition probabilities, and for the S operator. (auth)

10123 IMPROVED SELF-CONSISTENT CONFIGURATION INTERACTION. Serafin Fraga (Univ. of Alberta, Edmonton). J. Math. Phys. (N. Y.), 6: 18-23(Jan. 1965).

The configuration interaction method is reformulated, using general coupling operators. The new formulation proves that the configuration interaction procedure leads to self-consistent results for the set of configurations chosen and makes it possible to include a self-consistent contribution of the continuum in practical calculations. (auth)

10124 POSITION AND INTRINSIC SPIN OPERATORS IN QUANTUM THEORY. R. A. Berg (Lockheed Aircraft Corp., Palo Alto, Calif.). J. Math. Phys. (N. Y.), 6: 34-9 (Jan. 1965).

The problem of defining position and intrinsic spin operators in terms of the generators of the inhomogeneous Lorentz group is considered. These operators are taken to have the properties usually attributed to them in nonrelativistic quantum theory: their commutation relations must have the commonly accepted form. These commutation relations are then shown to define the intrinsic spin uniquely. The position operator is shown to be also essentially uniquely determined. Explicit forms of the spin and position operators for some special representations are exhibited. The relation of these operators to the spin and position operators of the spin-$\frac{1}{2}$ Dirac theory in the Foldy–Wouthuysen representation is considered. A heuristic derivation of the spin operator is given. (auth)

10125 ON THE NUMBER OF BOUND STATES OF A GIVEN INTERACTION. Gian Carlo Ghirardi and Alberto Rimini (Università, Trieste, Italy). J. Math. Phys. (N. Y.), 6: 40-4(Jan. 1965).

A method for deriving bounds to the number of bound states of a given interaction is built up. The class of interactions for which the method works includes nonlocal as well as local interactions. Problems with many channels and spin-dependent interactions can also be treated. Some bounds are explicitly given. (auth)

10126 CONTINUOUS-REPRESENTATION THEORY. V. CONSTRUCTION OF A CLASS OF SCALAR BOSON FIELD CONTINUOUS REPRESENTATIONS. John R. Klauder and James McKenna (Bell Telephone Labs., Inc., Murray Hill, N. J.). J. Math. Phys. (N. Y.), 6: 68-87(Jan. 1965).

A large class of continuous representations of separable Hilbert spaces is constructed with the aid of representations of the canonical commutation relations (CCR) for a scalar boson field $\phi(f)$ and its canonical conjugate $\pi(g)$. A representation of the CCR for a scalar boson field consists of two operator-valued functions $V[g]$ and $W[f]$, defined for all f, g in Schwartz's space S of real test functions, where $V[g]$ and $W[f]$ are unitary operators defined on some separable Hilbert space H, and which satisfy the commutation relations $V[g]W[f] = e^{-i(f,g)}W[f]V[g]$. These unitary operators are related to the field and its momenta by $V[g] = e^{-i\pi(g)}$, $W[f] = e^{i\phi(f)}$. A family of such representations is explicitly constructed with the help of von Neumann's theory of infinite direct products of Hilbert spaces, the pertinent parts of which are reviewed. A continuous representation C of the Hilbert space H is composed of a linear vector space of complex, bounded, continuous functionals defined on $S \times S$. These functionals are defined for all $\Psi \in H$ by $\psi(f,g) = (V[g]W[f]\Phi_0,\Psi)$. In this definition, Φ_0 is a fixed unit vector in H. The properties of the functions in C depend on the choice of the representation of the CCR and on the choice of Φ_0. When C is constructed with the aid of an irreducible representation of the CCR, an inner product can be defined for all pairs of functionals in C by an intuitively meaningful, rigorously defined integral in the sense of Friedrichs and Shapiro. With this inner product, C is a complete Hilbert space congruent with H. As in all continuous representations, a reproducing kernel exists and determines the functions in the continuous representation. One such space is closely related to a space of analytic functionals introduced by Segal and Bargmann. The representation of various operators as kernels and as functional derivatives is discussed. Finally, the construction of a vast number of unitary invariants for a representation of the CCR is used to establish the unitary inequivalence of uncountably many of the representations that are constructed. (auth)

10127 THE STATURE OF SPACE AND THE FORMALISM OF RELATIVISTIC QUANTUM THEORY. PART I. Yrjoe Ahmavaara (Univ. of Turku, Finland). J. Math. Phys. (N. Y.), 6: 87-93(Jan. 1965).

The structure of a Euclidean space can be approached, with an unlimited accuracy, by a part of a maximally ordered finite linear space. Accordingly, all the physical theories based on the space–time continuum can also be considered in such a finite space–time. The finiteness of the underlying space makes also some new kinds of theories possible. Among them is a purely group theoretical formalism of relativistic quantum theory, including a free-particle theory as well as a group formalism of particle interactions. The free-particle formalism of a finite space–time is considered. An essential difference in comparison with the formalism of continuous space–time is that there is, as a consequence of the relations of Euclidicity to be imposed on observable 4-vectors, a nontrivial spectrum of momentum, mass, and energy in a finite geometry. (auth)

10128 INVARIANT APPROACH TO THE GEOMETRY OF SPACES IN GENERAL RELATIVITY. Carl H. Brans (Loyola Univ., New Orleans). J. Math. Phys. (N. Y.), 6: 94-102(Jan. 1965).

A procedure is described for obtaining a complete, invariant classification of the local, analytic geometries and matter fields in general relativity by a finite number of algebraic steps. The approach is based on an extension of the classification scheme to include differential invariants of all orders and to provide maximally determined standard frames of vectors at each point. It is further shown that the resultant invariant functions can be replaced, in a finite number of algebraic steps, by special invariant functions which, while still uniquely representative of the geometry, can be assigned arbitrarily to produce all possible local, analytic solutions to the Einstein equations, in this representation. It is suggested that this type and special function scheme, obtainable from ideal geometric measurements in a finite number of steps, could be useful in general relativity. Unfortunately, due to the extensive algebra involved, this scheme has not yet been explicitly calculated, even for empty spaces. (auth)

10129 COMPLETE HIGH-ENERGY BEHAVIOR FOR CERTAIN PLANAR GRAPHS. M. Martinis (Imperial Coll. of Science and Tech., London). J. Math. Phys. (N. Y.), 6: 136-41(Jan. 1965).

The results obtained by Polkinghorne for the set of ladder diagrams is generalized to a certain set of planar graphs. The leading asymptotic term behaves as $s^{-1}(\ln s)^{7}$, and then the complete set of terms $s^{-1}(\ln s)^m$ is summed over m. The final result allows the writing of an equation for the Regge trajectory function. (auth)

10130 UNITARY SYMMETRY OF OSCILLATORS AND THE TALMI TRANSFORMATION. Bruria Kaufman (Weizmann Inst. of Science, Rehovoth, Israel) and Cornelius Noack. J. Math. Phys. (N. Y.), 6: 142-52(Jan. 1965).

The hamiltonian of an isotropic harmonic oscillator is invariant under unitary transformations in three dimensions

This well-known invariance is exploited in a treatment of the Talmi transformation, viz., the transformation of two-particle oscillator functions to center-of-mass and relative coordinates. A simple and transparent form of this transformation in terms of rotation matrices and Wigner coefficients of SU_3 is given. The calculation of these Wigner coefficients is described and the problem of degeneracies discussed. (auth)

10131 EXISTENCE OF PROPER MODES OF HELICON OSCILLATIONS. C. R. Legéndy (Cornell Univ., Ithaca, N. Y.). J. Math. Phys. (N. Y.), 6: 153-7(Jan. 1965).

It is shown that the class of electromagnetic problems for which the operator $i(\partial/\partial t)$ is self-adjoint extends beyond problems involving only insulators and perfect conductors. The class includes problems in which the perfect conductor is generalized to a medium with antisymmetric resistivity tensor. The latter medium approximates media in which helicon waves can propagate. Helicon waves are known to propagate in good conductors in a strong magnetic field B_0; two necessary conditions for self-adjointness of the operator $i(\partial/\partial t)$ are that the sample carrying helicons must not have a finite portion parallel to B_0 and must be surrounded by a reflecting surface that prevents energy from escaping. (auth)

10132 EXACT STATISTICAL THERMODYNAMICS OF GRAVITATIONAL INTERACTIONS IN ONE AND TWO DIMENSIONS. Allan M. Salzberg (Univ. of Minnesota, Minneapolis). J. Math Phys. (N. Y.), 6:158-60(Jan. 1965).

The exact equilibrium statistical mechanics of one- and two-dimensional gases, in which the particles interact through gravitational forces, is obtained. It is found that these systems are characterized by nonextensive thermodynamics leading to behavior somewhat reminiscent of the formation of a star from interstellar dust. (auth)

10133 WIGNER REPRESENTATION OF QUANTUM OPERATORS AND ITS APPLICATIONS TO ELECTRONS IN A MAGNETIC FIELD. Ryogo Kubo (Univ. of Pennsylvania, Pittsburgh and Tokyo Univ.). J. Phys. Soc. Japan, 19: 2127-39(Nov. 1964).

The Wigner representation $F_s(p,q)$ of a quantum operator $F(p,q)$ is defined by $F_s(p,q) = h \operatorname{Tr} F(p,q)\Delta(p - p, q - q)$ where Δ is a quantum analog of a delta function in the phase space. This gives in particular the Wigner distribution function for a density operator. Basic theorems are summarized for the computation rules for quantum-mechanical operators in the Wigner representation. This is applied, in particular, to electrons in a magnetic field, for which a Wigner distribution function is introduced to describe the distribution of physical momenta $\vec{\pi} = m\vec{v}$, $\vec{v}$ being the velocity, and the position x. This description has the advantage to avoid the use of a vector potential and so to be gauge-independent. As examples of application, the diamagnetism and the Hall effect are briefly treated. (auth)

10134 MEAN DRIFT APPROXIMATION OF CHARGED PARTICLE MOTION IN A STATIONARY MAGNETIC FIELD. V. D. Pletnev and G. A. Skuridin. Kosmich. Issled., 2: 51-63(Jan.-Feb. 1964). (In Russian)

A mean drift approximation, generalized to particle oscillations between magnetic mirrors, was developed for charged particle motion in a stationary inhomogeneous field. The equations of motion were derived by the Volosov method. It is shown that the mean drift approximation is congruent with adiabatic longitudinal invariance. The invariance disturbance rate in mean drift approximation was found. (tr-auth)

10135 DOUBLE TIME-TEMPERATURE GREEN FUNCTIONS FOR AN INTERACTING MIXED SYSTEM OF BOSONS AND FERMIONS. M. Savoia (Università, Bologna and Istituto Nazionale di Fisica Nucleare, Bologna), V. Bortolani, and J. Sawicki. Nuovo Cimento (10), 35: 36-53(Jan. 1, 1965).

The technique of the double time-temperature Green functions is applied to study the excitation spectrum and the dynamical correlations of a mixed system of interacting bosons and fermions. The previously found dispersion laws for the excitation spectra are reobtained, and the approximations involved are discussed. The Van Hove-Placzek method for calculating the cross sections for scattering of particles (or photons) from a system of atoms is applied, and the pertinent correlation functions are calculated from the respective Green functions. The nonresonant and the resonant scatterings are discussed. As a numerical example the scattering of photons from a homogeneous (dilute) mixture of liquid ^{4}He + liquid ^{3}He at a very low temperature is discussed. In particular, a modified Brueckner-Sawada pseudopotential is applied. The spectra for small momentum transfer q exhibit two peaks: one of the collective fermion-phonon resonance, the second of the zero sound character. (auth)

10136 TWO-PARTICLE GREEN'S FUNCTION AND THE DERIVATION OF THE BOLTZMANN EQUATION. [PART] II. L. Pičman (Univ. of Maryland, College Park). Nuovo Cimento (10), 35: 66-84(Jan. 1, 1965).

The theory, which expresses the response to the external field through the set of three functions F_m, is used. These functions satisfy a system of coupled linear integral equations which was derived from a version of the Bethe-Salpeter equation. The approximations in kernels are considered, which are applicable for description of the high-frequency and low-frequency sound propagation. Finally, for $\omega\tau \ll 1$, the single integral equation of the linearized Boltzmann type is derived and the kernel of this equation is found to be identical with the Boltzmann one. (auth)

10137 LIGHTLIKE SOLUTIONS OF THE BETHE-SALPETER EQUATION. A. Bassetto (Università, Padua and I.N.F.N., Padua), S. Ciccariello, and M. Tonin. Nuovo Cimento (10), 35: 292-7(Jan. 1, 1965).

It is shown that an eigenvalue of the B. S. equation in the ladder approximation for a vacuumlike bound state is also an eigenvalue of the corresponding B. S. equation for a lightlike bound state. A way of constructing solutions is indicated. (auth)

10138 REMOVAL OF INFRARED DIVERGENCES. A. Peres (Israel Inst. of Tech., Haifa). Nuovo Cimento (10), 35: 322-3(Jan. 1, 1965).

An alternative approach for the removal of infrared divergences in quantum electrodynamics is proposed. The method is simple and leads to equivalent results. (C.E.S.)

10139 HIGHLY SINGULAR POTENTIAL AND PERATIZATION. H. H. Aly, Riazuddin, and A. H. Zimerman (Univ. of Rochester, N. Y.). Nuovo Cimento (10), 35: 324-8(Jan. 1, 1965). (UR-875-51)

The behavior of both the wave function and the phase shift in the radial Schroedinger equation for highly singular repulsive potentials is considered. A potential of the form $V = g\,\{\exp\,[2/x]/x^4\} + g'\,(1/x^4) = g\,\{\exp\,[2/x] + \nu_1^2/x^4\}$ where $g\nu_1^2 = g'$ is used. It is shown that the peratization technique gives the correct solution for this class of potentials when both the exact solution of the Schroedinger equation and the phase shift are compared to the ones obtained by the peratization technique. (C.E.S.)

10140 SYMMETRICAL CO-ORDINATES IN RELATIVITY. A. Gamba (Università, Genoa). Nuovo Cimento (10), 35: 329-30(Jan. 1, 1965).

The fundamental quadratic form of special relativity $-ds^2 = -dt^2 + dx^2 + dy^2 + dz^2$ is symmetrized by introducing the real substitutions $t = \frac{1}{2}(A_1 + A_2 + A_3 + A_4)$, $x = \frac{1}{2}(A_1 + A_2 - A_3 - A_4)$, $y = \frac{1}{2}(A_1 - A_2 + A_3 - A_4)$, and $z = \frac{1}{2}(A_1 - A_2 - A_3 + A_4)$. The resulting symmetrized equation is invariant not only under the Lorentz group L, but also under the symmetric group π_4 of the permutations of the four variables A'_2. Under the latter group the four coordinates A'_2 do not transform according to an irreducible representation as they do under the group L. (C.E.S.)

10141 INELASTIC EFFECTS IN THE N/D METHOD. H. Munczek (Universidad, Buenos Aires). Phys. Letters, 13: 92-3(Nov. 1, 1964).

In s-matrix theory one seeks to express the partial wave scattering amplitudes in terms of their analytic properties. To achieve this Chew and Mandelstam introduced the N/D method. Alternative procedures that also remain within the frame of one channel calculations were proposed. On the other hand Bjorken proposed a generalization which requires the simultaneous treatment of all intervening channels. In these methods the partial wave amplitude is finally expressed as a quotient of two functions, the difference among the procedures being the distribution of singularities between the numerator and denominator. Yet in every one of them it is claimed that the bound state poles arise from zeros of the denominator. Since this is not a clear cut situation, a simple example from potential theory which enables one to compare the different methods with the known Fredholm solution is discussed. The result indicates that only Bjorken's multichannel method may have unambiguously the charactistics of the correct solution. (C.E.S.)

10142 SINGULAR POTENTIALS IN THE LIPPMAN-SCHWINGER EQUATION. B. A. Arbuzov and A. T. Filippov (Joint Inst. for Nuclear Research, [Dubna], USSR). Phys. Letters, 13: 95-6(Nov. 1, 1964).

Consistent solutions in unrenormalizable theories are considered. Inasmuch as the situation in the field theory is somewhat complicated, a model example, which bears a resemblance to the unrenormalizable theories, is investigated. The repulsive potentials b/r^{2n}, $b > 0$ in the Lippman-Schwinger equation for the partial wave scattering amplitude are considered. It is noted that the Lippman-Schwinger equation for the full amplitude does not exist in this case. (C.E.S.)

10143 RELATIONS BETWEEN INTERNAL SYMMETRY AND RELATIVISTIC INVARIANCE. Louis Michel (Univ. of Wisconsin, Madison). Phys. Rev., 137: B405-8(Jan. 25, 1965).

The problem of combining relativistic invariance and internal symmetry is reviewed, and a critical evaluation of very recent papers on this subject is made. It is proposed that the Poincaré group P is not a subgroup of the group E of invariance of a relativistic quantum theory, but is the quotient $P = E/S$, where S is the internal symmetry group. Pertinent mathematical results are given. (auth)

10144 ASPECTS OF COUPLED SYSTEMS—CLASSICAL NONEXPONENTIAL DECAY. Gregg Edwards (Rice Univ., Houston, Tex.). Phys. Rev., 137: B452-4(Jan. 25, 1965). (TID-20930)

The classical motion of an oscillator coupled to (1) a string, (2) a Klein-Gordon field, and (3) a lattice is solved in closed form and examined. With the medium initially at rest its response to a unit, point impulse determines oscillator decay. If there are branch cuts or gaps in the response-function frequency plane, there are either bound states with no decay or nonexponential terms which asymptotically dominate. The coupling mechanism may induce resonances in addition to those of the uncoupled system. The oscillator decays exponentially only if the medium dispersion relation has a stringent form which allows dissipation but precludes dispersion for most physically relevant media. (auth)

10145 BOOTSTRAP GRAVITATIONAL GEONS. Arthur Komar (Yeshiva Univ., New York). Phys. Rev., 137: B462-6(Jan. 25, 1965).

It is shown that there exist solutions of the vacuum Einstein field equations with the property that exterior to the Schwarzschild radius, $R = 2m$, the solution appears to be that of a static spherically symmetric particle of mass m (that is, strictly Schwarzschild). Interior to the Schwarzschild radius the topology remains Euclidean and the solutions have the property of a bundle of gravitational radiation so intense that the mutual gravitational attraction of the various parts of the bundle prevent the radiation from spreading beyond the Schwarzschild radius. It is not known whether there exist solutions of this type which remain nonsingular for all times; however, no singularity can ever be observed exterior to the Schwarzschild radius. The Cauchy data for one such solution are explicity exhibited. (auth)

10146 ELECTRODYNAMIC PARADOX AND THE CENTER-OF-MASS PRINCIPLE. T. T. Taylor (Loyola Univ. of Los Angeles). Phys. Rev., 137: B467-71(Jan. 25, 1965).

The interaction of a moving charged particle with a stationary or quasistationary current configuration is analyzed with the aid of the center-of-mass principle, and particular attention is given to the circumstance in which the charged particle is unforced. In this situation, the induced displacement of the current configuration is severely limited in extent and may not occur at all. The special case in which the displacement is as previously predicted is discussed in detail. Another case in which there is no displacement is also considered. (auth)

10147 GROUND STATE AND LOW EXCITED STATES OF A BOSON LIQUID WITH APPLICATIONS TO THE CHARGED BOSON SYSTEM. Keok Kyo Lee and Eugene Feenberg (Washington Univ., St. Louis). Phys. Rev., 137: A731-42(Feb. 1, 1965).

The maximum deviation of the radial distribution function g(r) from its asymptotic value, $g(\infty) = 1$, is used as an expansion parameter in calculating the properties of a degenerate boson system. The uniform limit, defined by the condition $1 - g(0) \ll 1$, holds at low densities under appropriate constraints on the Fourier transforms of the interaction potential and also at high densities for the charged-boson system. In the uniform limit a procedure based on a Jastrow-type trial function, the Wu-Feenberg functional for the kinetic energy, the Kirkwood superposition approximation, or the more accurate Abe form for the three-particle distribution function, yields the Bogoliubov formulas for the ground-state energy and the excitation energies of a degenerate or nearly degenerate boson system. Results for the ground state of the high-density charged-boson system include $\langle KE\rangle/N = -\{[(1/5)(\langle PE\rangle/N)] + O(r_s^{3/4})\}$, and $E/N \leqq -[(0.8031/r_s^{3/4}) + 0.028]$. Numerical results are also computed at intermediate and moderately low densities ($0.01 \leqq r_s \leqq 100$). (auth)

10148 PARTICLE-LIKE SOLUTIONS TAKING INTO ACCOUNT GRAVITATION. M. I. Stakvilevichus. Vestn. Mosk. Univ., Ser. III, Fiz, Astron., No. 3, 86-90(May-June 1964). (In Russian)

Gravitational effects on particle-like solutions for a scalar complex potential were investigated for the case in which the gravitational field is formed by the mass of a spherically symmetric scalar potential. It is shown that the gravitational effects are negligible when the ratio of the gravitational radius to the radius of the particle is much smaller than unity. It is illustrated that for the particle with the radius $r_0 \sim 10^{-13}$cm and mass $\mu \sim 10^{27}$g gravitational corrections are 10^{-40}%. (tr-auth)

10149 LIE'S EQUATIONS FOR THE ROTATION GROUP. S. Datta Majumdar (Univ. of Calcutta). Zh. Eksperim. i Teor. Fiz., 47: 1509-14(Oct. 1964). (In Russian)

By introducing an extra variable, Lie's equations for the three dimensional rotation group are converted into a set of three unlinked equations for determining a single unknown function. The equations are solved by the standard methods of analysis and a generating function for the representation coefficients is obtained. The same technique is then applied to the Lorentz group and the theory of the finite representations is seen to follow from an elementary property of the differential equations. (auth)

10150 DISPERSION RELATIONS FOR A CLASS OF NONLOCAL POTENTIALS. James Emery Mazo. Thesis, Syracuse, N. Y., Syracuse Univ., 1963. 64p.

Single and double variable dispersion relations are proven for a class of nonseparable, nonlocal potentials given by $V(\bar{r},\bar{r}') = \int_{\mu_0}^{\infty}\int_{m_0}^{\infty} \sigma(\mu,m)\,[(e^{-\mu r}/r) + (e^{-\mu r'}/r')](e^{-m|\bar{r}-\bar{r}'|}/|\bar{r}-\bar{r}'|)d\mu dm$. The main feature of these relations is a new left hand cut in the energy variable, beginning at $s = -m_0^2$. Also, it is shown that the combination of unitarity and the double dispersion relation does not determine both of the double spectral functions of the problem. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10151 AN INDEFINITE METRIC THEORY OF FINITE QUANTUM ELECTRODYNAMICS. Moo-young Han. Thesis, Rochester, N. Y., Univ. of Rochester, 1964. 137p.

A finite relativistic quantum field theory of electromagnetic interactions of charged fermions is formulated following the outline given in a previous work of Professor Sudarshan; the theory involves as an essential ingredient the use of an indefinite metric. In addition to the electromagnetic field and a normal fermion field, the theory contains two auxiliary fermion fields that have the same quantum numbers as the normal fermion field but have different mass parameters and are quantized in a generalized Hilbert space in which the metric is not positive definite. It is a linear combination of normal and auxiliary fermion fields that is locally coupled to the electromagnetic field. The two mass parameters of the auxiliary fields regulate the fermion propagation function in the theory in such a way that the conventional ultraviolet divergence difficulties no longer appear and consequently all renormalizations are finite and analytic functions of bare parameters. The requirement that the photons in the theory be zero mass transverse quanta gives two transcendental mass renormalization equations, which are used to determine the two auxiliary masses as functions of the coupling constant and the normal fermion mass. As a test of an agreement with the existing experimental data, the anomalous magnetic moment of an electron is calculated to the second order in the coupling constant and an agreement is achieved at one particular choice among the solutions for the two auxiliary masses. New aspects of the renormalization procedures are discussed. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10152 ELEMENTS OF THE MANY-BODY PROBLEM. David Pines. I1-43 of "1962 Cargèse Lectures in Theoretical Physics." New York, W. A. Benjamin, Inc., 1963.

A brief survey of the elementary excitations found in many-body systems is made. The low-lying states, statistical mechanics, and transport processes of such systems are explained in terms of two kinds of elementary excitations, quasi-particles and collective modes. A mathematical description of the response of a many-body system to an external longitudinal probe is given. Such probes (e.g., the inelastic scattering of an external particle) offer a way of measuring directly the excitation spectrum of the system. The random phase approximation is derived by the equation of motion, Boltzmann equation, and field theoretic methods; and is applied to a high density electron gas, with emphasis on the physical phenomena involved. The excitation spectrum of liquid helium II is considered, with attention given only to excitations from the ground state, at $T = 0$. (L.B.S.)

10153 APPLICATION OF FIELD THEORETICAL METHODS TO MANY-BOSON SYSTEMS. N. Hugenholtz. p.III1-31 of "1962 Cargèse Lectures in Theoretical Physics." New York, W. A. Benjamin, Inc., 1963.

The techniques of field theory are used to calculate the properties of many-boson systems, following an analogous treatment for many-fermion systems. The zero-momentum state is eliminated by reformulating the perturbation theory, and the difficulty associated with the divergent terms of the Goldstone formula is overcome in the Green function formalism. It is shown that the energy of the ground state and single-particle excitations can be found in terms of one-particle Green's functions. Exact integral equations are obtained from symbolic representations of the Green functions, and application is made to the limiting case of weak interactions. The results are generalized for the case of a dilute Bose gas with a more general two-body interaction. The theorem on the chemical potential and the theory of a system of fermions with attractive forces are discussed. (L.B.S.)

10154 THEORY OF FERMI LIQUIDS. Philippe Nozières. p.IV1-37 of "1962 Cargèse Lectures in Theoretical Physics." New York, W. A. Benjamin, Inc., 1963.

Landau's theory of Fermi liquids is developed, and a discussion is given on the magnetic properties of a Fermi liquid: speed of sound, compressibility, magnetic susceptibility; and on transport properties: collective modes, conductivity. The relation between Landau's phenomenological theory and the perturbation formalism is shown. (L.B.S.)

10155 QUASI-BOSON APPROXIMATION AND QUANTUM ELECTRODYNAMICS. B. Jancovici. p.VIII-7 of "1962 Cargèse Lectures in Theoretical Physics." New York, W. A. Benjamin, Inc., 1963.

A general account of the quasi-boson approximation is given, and application is made to vacuum polarization and charge renormalization in quantum electrodynamics. The degenerate electron gas theory is generalized to the case of an extremely high density such that the Fermi energy becomes relativistic. (L.B.S.)

10156 THE THEORY AND APPLICATION OF REGGE POLES. Fredrik Zachariasen. p.X1-42 of "1962 Cargèse Lectures in Theoretical Physics." New York, W. A. Benjamin, Inc., 1963.

A phenomenological treatment of Regge poles is presented. The historic motivation, derivation of Regge poles in potential scattering, conjectures of the existence of similar poles in field theory, and comparison of predictions with experiments are discussed. (L.B.S.)

10157 STRONG-INTERACTION S-MATRIX THEORY WITHOUT ELEMENTARY PARTICLES. Geoffrey F. Chew. p.XI1-37 of "1962 Cargèse Lectures in Theoretical Physics." New York, W. A. Benjamin, Inc., 1963.

A survey of the development of S-matrix theory is presented. It is shown how the principle of maximal analyticity in angular momentum as well as linear momentum is related to the notion that all strongly interacting particles are dynamical composites of one another. It is assumed that the forces for strong interactions adjust themselves to reach the maximum strength possible consistent with unitarity; a concrete expression of this maximum-strength principle is given. The continuation in angular momentum, properties of Regge poles, properties of residues, and the Sommerfeld-Watson transform are investigated. Trajectories in the high energy region are considered, and consequences of the conjecture of the existence of the Pomeranchuk trajectory (the top-level trajectory) are discussed. Some miscellaneous predictions and work in progress are mentioned. (L.B.S.)

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Refer also to abstract 10412.

10158 (AFCRL-64-204(Vol. 3)) SUB ELF GEOMAGNETIC FLUCTUATIONS. VOLUME III. OBSERVATIONS OF TRANSIENT AND BACKGROUND VLF, ELF AND SUB ELF ELECTROMAGNETIC EFFECTS PRODUCED BY HIGH ALTITUDE NUCLEAR DETONATIONS. Final Report. Lee Tepley, R. C. Wentworth, Kay G. Lambert, H. V. Prentiss, K. D. Amundsen, and D. R. Hillendahl (Lockheed Missiles & Space Co., Palo Alto, Calif.). Dec. 26, 1963. Contract AF19(628)-462. 71p. (AD-444557)

This volume deals with two separate categories of elf and sub-elf effects produced by high-altitude nuclear detonations. In the first category are electromagnetic transients produced by the explosions. In the second category are variations in background effects resulting from bomb-produced changes in the electromagnetic environment. Operation of Pacific stations and the instrumentation employed for the elf and sub-elf measurements are discussed. Geomagnetic fluctuations and electromagnetic waves produced by high-altitude nuclear detonations in the summer of 1962 series are discussed. Also presented are signals from three high-altitude tests conducted by the USSR. Bomb-produced variations in background electromagnetic radiation are discussed. These results are limited to a single event (9 July 1962), but data are presented in a broad frequency range extending through the elf band. (auth)

10159 (AFCRL-64-809) A PLASMA RESONANCE AND ELECTRON TEMPERATURE EXPERIMENT. Scientific Report No. 3, Alvin M. Despain (Utah. Univ., Salt Lake City). Aug. 3, 1964. Contract AF19(628)-447. 85p. (AD-608494). $3.00(OTS).

Plasma and ionosphere parameters, measurement techniques, design of a rocket-borne experiment to measure plasma resonance and electron temperature, and preliminary flight results are discussed. The ionosphere, important in communications and studies of geophysics, may be described by various parameters. Two parameters of special interest are electron density, characterized by the plasma frequency, and electron temperature. A rocket-borne experiment that measures the electrical characteristics of a probe or antenna can yield these important ionospheric parameters. Such an experiment was designed to measure the d-c volt-ampere characteristics of a rocket-borne radio-frequency-excited probe. The design of the experiment began with the definition of the experiment requirements. Next the design of the electronic system was carried out. Then the experiment was incorporated into a multi-purpose ionospheric rocket payload. (auth)

10160 (NASA-TN-D-2218) HYDROMAGNETIC STABILITY OF STELLAR ATMOSPHERES. Satya P. Talwar (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Jan. 1965. 14p. $1.00(OTS)

The effect of a horizontal magnetic field on the equilibrium of an inviscid, perfectly conducting, stratified plasma under uniform rotation is investigated. The equations of the problem are established when both the density and magnetic field vary with the vertical distance. Then special density distributions are studied, first a layer of stratified plasma, and secondly a configuration of incompressible fluid topped by a stratified compressible fluid. Criteria of instability are derived. (auth)

10161 (RM61TMP-33) COMPUTER SOLUTION OF TRANSIENT AND QUASIEQUILIBRIUM ATMOSPHERIC DEIONIZATION EQUATIONS. Walter F. Dudziak (General Electric Co. Technical Military Planning Operation, Santa Barbara, Calif.). May 1, 1961. Contract DA49-146-SZ-038. 294p. (DASA-1233; AD-604069). $6.00(OTS)

Two computer programs are described for use on the IBM-704/7090 electronic data processing machines or any large computer accepting FORTRAN. The necessary modifications for use on these two computers are simple and self-evident. One of these programs deals with the numerical solution of the three equation, transient deionization phenomena. The second program deals with the solution of the deionization phenomena under quasi-equilibrium conditions that are derivable from the three equation transient solution. The second quasi-equilibrium computer program also calculates the modified collision frequency as effected by temperature and the presence of partial ionization, and the differential and integrated absorption of electromagnetic waves through the assumed ionosphere. (auth)

10162 (SEL-63-110) THE DISTRIBUTION OF IONS AND ELECTRONS IN THE EARTH'S EXOSPHERE. Technical Report No. 4 and Technical Report No. 3412-3. J. J. Angerami and J. O. Thomas (Stanford Univ., Calif. Radioscience Lab.). Dec. 1963. 13p. (AFOSR-64-1470; AD-604040). $4.00(OTS).

The factors that govern the distribution of electrons and ions in the earth's exosphere are discussed. The theory takes into account the effect of the electric field which arises from charge separation, the centrifugal force arising from the rotation of the earth, and the effect of the earth's gravitational field. It is assumed that the charged particles are constrained to move only along the direction of the earth's magnetic lines of force. The modifications that result in the electron and ion distributions when a temperature variation is assumed along a line of force are also considered. The results predicted by the theory are compared with experimental observations of the exospheric plasma obtained using whistlers and topside ionograms from the Alouette satellite. (auth)

10163 RAPID DETERMINATION OF AURORAL HEIGHTS. J. H. Brandy and J. E. Hill (Defence Research Northern Lab., Fort Churchill, Manitoba, Can.). Can. J. Phys., 42: 1813-19(Sept. 1964).

A method using wide-angle cameras was developed which reduces the time and labor required for the parallactic determination of auroral heights. The system consists of two wide-angle or all-sky cameras at a fixed separation of 21.65 km. Simultaneous photographs from the two stations are projected on a predetermined grid from which the parallax can be read directly. Heights on arcs and bands having well defined borders can be found over a much greater length than before and with comparative ease. The system is particularly useful during the flight of rockets into aurora and for studies of height versus any other measurable property of aurora. The accuracy obtainable is approximately ±3%. (auth)

10164 TOTAL ELECTRON CONTENT MEASUREMENTS DURING THE JULY 20, 1963, SOLAR ECLIPSE. L. A. Maynard and J. L. McAlpine (Defence Research Telecommunications Establishment, Ottawa). Can. J. Phys., 42: 1820-2(Sept. 1964).

Total electron content measurements of the earth-moon interspace were made by measuring the Faraday rotation of the returned echoes from the moon at Prince Albert, Saskatchewan, during the July 20, 1963, solar eclipse. The relative change of total ionospheric electron content was calculated from the data and is plotted and compared with the percentage of the solar disk obscured as a function of time. A relaxation time of about 90 min for the whole of the ionosphere was obtained from the observed time delay between eclipse maximum and electron-content minimum. Comparisons were made with measurements on the days preceding and following the eclipse. (M.J.T.)

10165 THE DAYTIME EQUATORIAL F-LAYER. R. B. Norton and T. E. VanZandt (National Bureau of Standards, Boulder, Colo.). J. Atmospheric and Terrest. Phys., 26: 1047-54(Nov. 1964).

It is shown that the main features of the daytime equatorial F region can be explained by rapid photo-ionization and recombination in a neutral atmosphere whose temperature increases rapidly during the morning and is roughly constant during the afternoon. The main features explained in this way are the exponential shape of the electron density versus height profiles, the morning maximum in curves of electron density at fixed heights versus time, and the gradual rise of h max F2 during the day to great height. It is suggested that the increase of f_0F2 after sunset observed in the subequatorial regions is due to the rapid cooling of the atmosphere and ionosphere after sunset. (auth)

10166 TEMPERATURE VARIATION AT THE F-LAYER MAXIMUM DURING A SUNSPOT CYCLE. Peter Stubbe (Max-Planck-Institut für Aeronomie, Lindau/Harz, Ger.). J. Atmospheric and Terrest. Phys., 26: 1055-68(Nov. 1964).

Both the half-layer thickness Y_m of a parabolic approximation to the F2-layer peak and its height h_m were deduced from ionograms taken at Lindau. Undisturbed intervals around noon and midnight for the December months of the years 1953-1960 were selected. The h_m and Y_m data show strong dependence on the Zürich sunspot number R. It is shown analytically that this relation can be interpreted by a reasonable temperature variation at the F-layer peak during the respective sunspot cycle. The calculations themselves assume that ion production by solar radiation and electron losses by a two-stage process consisting of an ion-atom interchange reaction and a dissociative recombination and the ambipolar diffusion are the main processes responsible for the height and shape of the F-layer peak, e.g. Y_m. The results are: during sunspot minimum T = 1000°K (h_m = 200 km) at noon and 900°K (h_m = 300 km) at midnight; during sunspot maximum T = 1350°K (h_m = 340 km) at noon and 1250°K (h_m = 480 km) at midnight. (auth)

10167 A STUDY OF GEOMAGNETIC ANOMALY DURING I.G.Y. C. S. R. Rao and P. L. Malthotra (All India Radio, New Delhi). J. Atmospheric and Terrest. Phys., 26: 1075-85(Nov. 1964).

The geomagnetic anomaly in the F2 layer was studied on quiet and disturbed days for the months of March and September during the year 1958. The data for stations in the Asian, American, and African zones were studied separately. The diurnal variation of the width of the anomalous belt and the depth of the equatorial trough were determined for the three zones separately. The analysis indicates that the belt develops earlier in the Asian zone than in the American or African zones and there is a marked asymmetry in the variations in the northern and southern latitudes in the Asian and American zones. While there does not appear to be much difference in the width of the belt on quiet and disturbed days, there is a definite decrease in the depth of the trough on disturbed days as compared to that on quiet days. The width of the belt in the Asian zone is generally larger than that in the American zone. The general features observed are in agreement with ideas of meridional transport of ionization and abnormal increase in the thickness of the F2 layer at equatorial regions. There is some evidence of inhibition of the meridional transport of ionization on disturbed days. (auth)

10168 GEOMAGNETIC EFFECTS ASSOCIATED WITH RELATIVISTIC FLARES. R. V. Subrahmanyan (Astrophysical Observatory, Kodaikanal, India). J. Atmospheric and Terrest. Phys., 26: 1119-26(Nov. 1964).

Solar flare effects associated with relativistic flares (flares during which very fast solar particles, mainly protons, of cosmic-ray energies were observed at ground level) are compared with those of nonrelativistic flares. All flares accompanied by magnetic crochets in the horizontal force of the earth's field at Kodaikanal (lat 10°2′N; long 77°5′E; magnetic dip, 3°5′N) during a six year period (1956 through 1961) were classified into two types. The times of occurrence, amplitudes, durations, and impulsive nature of the geomagnetic effects associated with the two types of flares are found to be different in nature. The plausible causes are discussed in terms of enhanced D-region ionization caused by strong hardening of a solar x-ray burst at 1 to 8 Å, associated with the high-energy part of the electron spectrum responsible for intense microwave bursts, during relativistic flares. (auth)

10169 ELECTRIC FIELDS IN THE MAGNETOSPHERE ASSOCIATED WITH DAILY GEOMAGNETIC VARIATIONS AND THEIR EFFECTS ON TRAPPED PARTICLES. Hiroshi Maeda (High Altitude Observatory, NCAR, Boulder, Colo.). J. Atmospheric and Terrest. Phys., 26: 1133-38(Nov. 1964).

Assuming that geomagnetic force lines in the magnetosphere are highly conductive electrically and act as equipotentials, it is postulated that electrostatic fields associated with ionospheric dynamo currents propagate into the magnetosphere along the lines of force without significant attenuation and have an important effect on geomagnetically trapped particles. The worldwide distribution of the E-region ionospheric electrostatic field was obtained previously for quiet and disturbed days from geomagnetic data for 1932-3. This distribution is expressed in a potential form, and equations are derived permitting the estimation of electric field at any point in the magnetosphere. The effect of magnetospheric charged-particle drifts due to these electric fields on geomagnetically trapped particles is discussed. The effects of magnetospheric motions on the time variation of the electron and ion density is also studied. (M.J.T.)

10170 LEVEL OF SOLAR RADIO FLUX IN THE 3000 Mc/s REGION AND ITS RELATION TO THE OCCURRENCE OF SUDDEN IONOSPHERIC DISTURBANCES. A. P. Mitra, C. V. Subrahmanyam, and Mirjana Karabin (Radio Propagation Unit, National Physical Lab., New Delhi, India). J. Atmospheric and Terrest. Phys., 26: 1138-42 (Nov. 1964).

It was suggested previously that centimeter burst emission from the sun and the ionizing x radiation responsible for nondeviative absorption in the D layer during a SID originate from the same region in the solar atmosphere and are generated by similar emission mechanisms. During July 1957 to December 1958, of 490 optical flares of class 2- and above, 140 flares were not followed by centimeter bursts or SID's. The characteristics of these 140 flares were ascertained by a study of their position on the solar disc and of the level of solar radio emission at 3000 Mc. It was found that there was no preferred position for the flares, but that the flares not producing SID corresponded to an unusually low level of the solar radio emission. The primary criterion of SID production is that the general level of microwave solar flux be above a threshold value, about 220×10^{-22} w m^{-2} $(cm/sec)^{-1}$ for 3000 Mc. (M.J.T.)

10171 MECHANISMS OF GEOMAGNETIC CONTINUOUS PULSATIONS AND PHYSICAL STATES OF THE EXOSPHERE. Takao Saito (Tohoku Univ., Sendai). J. Geomagnet. Geoelec., 16: 115-51(1964).

Mechanisms of pc 2,3 (5 to 40 sec), pc 4 (40 to 150 sec), and pc 5 (150 to 900 sec) are studied. More than 6000 series of continuous pulsations are analyzed from the magnetograms at Fredericksburg, Byrd Station, Yakutsk, Onagawa, and 20 other stations. Geomagnetic micropulsations of pc 4 and pc 5 are caused by hydromagnetic standing oscillations along the geomagnetic field lines, while pc 2,3 are induced by hydromagnetic standing oscillations below the region of maximum Alfvén wave velocity. The world-wide shape of the base of the protonosphere surrounding the earth is inferred from the distribution of pc 2,3 period, namely, an inverted U-type diurnal variation and a latitudinal dependence of the period. A clear U-type diurnal variation in period for pc 4 and pc 5 seems to be due to the day-side compression of the geomagnetic field line by the solar wind. Nonseasonal annual variations in the pc 4 and pc 5 periods are detected. It is found that the nonseasonal variations are related closely with those in whistler dispersion, satellite drag, f_0F2, and f_0E. 113 references. (auth)

10172 COMMENTS ON AN INNER MAXIMUM OF MAGNETIC DISTURBANCE IN THE ANTARCTIC. Gerald F. Rourke (Avco Corp., Wilmington, Mass.). J. Geomagnet. Geoelec., 16: 161-4(1964).

The possibility of an inner maximum in magnetic activity during the summer in the Antarctic is investigated, using K indices and hourly ranges from data of four Russian magnetic observatories with similar K scales. It is found that the data do not warrant concluding that an inner maximum exists. (M.J.T.)

10173 ELECTRON DENSITY MEASUREMENT IN LIGHTNING FROM STARK-BROADENING OF Hα. Martin A. Uman and Richard E. Orville (Univ. of Arizona, Tucson). J. Geophys. Res., 69: 5151-4(Dec. 15, 1964).

Electron densities between 1×10^{17} and 5×10^{17} cm^{-3} were found for three lightning strokes by comparing the profiles of Stark-broadened Hα lines with theoretical profiles. The results are discussed and compared with electron density determinations made from line intensity measurements. (auth)

10174 THEORETICAL AND OBSERVED ACOUSTIC-GRAVITY WAVES FROM EXPLOSIVE SOURCES IN THE ATMOSPHERE. David G. Harkrider (California Inst. of Tech., Pasadena). J. Geophys. Res., 69: 5295-5321 (Dec. 15, 1964).

A matrix formulation is used to derive the pressure variation for acoustic-gravity waves from an explosive source in an atmosphere modeled by a large number of isothermal layers. Comparison of theoretical and observed barograms from large thermonuclear explosions leads to the following conclusions: (1) the major features on the barogram can be explained by the superposition of four modes; (2) different parts of the vertical temperature structure of the atmosphere control the relative excitation of these modes; (3) a scaled point source is sufficient to model thermonuclear explosions; (4) the observed shift in dominance of certain frequencies with yield and altitude can be explained by means of the empirical scaling laws derived from the direct wave near the explosion; and (5) out to 50° from the source, the observed variation of amplitude with distance can be accounted for by geometrical spreading over a spherical surface. (auth)

10175 THE MASS DENSITY, PRESSURE, AND ELECTRON DENSITY IN THREE LIGHTNING STROKES NEAR PEAK TEMPERATURE. Martin A. Uman, Richard E. Orville, and Leon E. Salanave (Univ. of Arizona, Tucson). J. Geophys. Res., 69: 5423-4(Dec. 15, 1964).

Results are presented of the calculation of mass density, total pressure, and electron density in three lightning strokes at 24,000°K, using an analysis method and basic data given by Uman et al. (J. Atmospheric Sci., 21: 306-310). (M.J.T.)

10176 PHYSICAL PROPERTIES OF THE POLAR WINTER MESOSPHERE OBTAINED FROM LOW-FREQUENCY PROPAGATION AND PARTIAL REFLECTION STUDIES. J. S. Belrose, L. R. Bodé, and L. W. Hewitt (Defence Research Telecommunications Establishment, Ottawa). J. Res. Natl. Bur. Std., 68D: 1319-23(Dec. 1964).

During the winter of 1963-64 observations of partial reflections at a frequency of 2.66 Mc were made at Resolute Bay (invariant magnetic latitude 84¼°) near local midnight. By using the different amplitudes of the ordinary and extraordinary backscattered waves, information was obtained about electron densities and electron collision frequencies. Electron densities range from 10 cm^{-3} at 80 km to 1000 cm^{-3} at 110 km. Collision frequency values are a factor of 2–4 times greater than average daytime results at lower latitudes. These observations, together with some indirect inferences based on low frequency propagation between Thule and Churchill (invariant magnetic latitude 79½° at path midpoint) are discussed, and it is concluded that (1) galactic cosmic rays are responsible for electron production below 90 km, (2) ionization rates in excess of galactic cosmic ray production are required for heights above 90 km, (3) effective electron loss rates below 90 km are markedly more rapid than dissociative recombination, and (4) the polar winter mesosphere is hotter than previous data suggest. (auth)

10177 RADIO-EMISSION FROM SHOCK WAVES NEAR THE EARTH AND IN INTERPLANETARY GAS. M. A. Gintsburg. Kosmich. Issled., 2: 64-70(Jan.-Feb. 1964). (In Russian)

Studies were made of 10 to 30 Hz radiation emitted by a shock wave near the earth and in interplanetary gas. An analysis was made of the radiation intensity and other effects produced by the shock wave (particle acceleration by deflected pulses, capture and acceleration by plasma waves, etc.). (tr-auth)

10178 DYNAMO ACTION IN THE IONOSPHERE AND MOTIONS OF THE MAGNETOSPHERIC PLASMA. I. SYMMETRIC DYNAMO ACTION. R. N. DeWitt and S.-I. Akasofu (Univ. of Alaska, College). Planetary Space Sci., 12: 1147-56(Dec. 1964).

In order to envisage the circulation pattern of the magnetospheric plasma produced by the dynamo action in the ionosphere, the distribution of the dynamo-induced electrostatic field resulting from basic ionospheric wind systems is studied. It is then shown by use of Maeda's field distribution that there exists a remarkable large-scale circulation of the magnetospheric plasma, inward (earthward) on the evening side of the magnetosphere and outward on the morning side. This motion is comparable to the motion produced by the earth's rotation and by zonal winds in the ionosphere. It is shown also that the electrostatic field can cause a considerable radial motion of some of the energetic particles in the radiation belt. (auth)

10179 LABORATORY STUDIES OF HELIUM ION LOSS PROCESSES OF INTEREST IN THE IONOSPHERE. E. E. Ferguson, F. C. Fehsenfeld, D. B. Dunkin, A. L. Schmeltekopf, and H. I. Schiff (National Bureau of Standards, Boulder, Colo.). Planetary Space Sci., 12: 1169-71(Dec. 1964).

Preliminary measurements of reaction rates for loss of thermal helium ions in reaction with molecular oxygen and nitrogen establish rather conclusively that the helium ions in the ionosphere will be lost in reaction with molecular nitrogen rather than molecular oxygen, in contrast to previous assumptions based on theoretical considerations. The rate of thermal He^+ loss in reaction with N_2 is measured to be 1.2 ± 0.3 times the rate for reaction with O_2. This conclusion is of considerable significance to atmospheric physics because the oxygen loss process contained the possibility of terrestrial helium escape and therefore the possibility of a steady state helium atmosphere. The nitrogen loss process does not have this possibility so that no satisfactory mechanism has yet been proposed which will allow a steady state helium atmosphere. The interpretation of recent atmospheric helium ion profiles obtained by rocket borne mass spectrometers appears to be inconsistent with the laboratory loss rate constants and current atmospheric theory. (auth)

10180 ROCKET STUDIES OF SPORADIC-E IONIZATION AND IONOSPHERIC WINDS. P. J. Bowen (London Univ.), K. Norman, A. P. Willmore, J.-M. Baguette, F. Murtin, and L. R. O. Storey. Planetary Space Sci., 12: 1173-7(Dec. 1964).

Simultaneous observations of positive ion density (by means of positive ion probes) and high-altitude winds (by scattering of sunlight in trails of alkali metal vapor) were made in three rocket firings at Hammaguir, Algeria, in order to study the correlation of sporadic E layers and high-altitude wind shears. On one occasion, a sporadic E layer was found to occur at 95 km where the E–W component of the wind was zero and the wind shear was in the sense predicted by the theory of Whitehead. However, on two occasions, layers were also observed near 115 km where the E–W wind component was zero, but the wind shear was in the opposite sense. These phenomena appear to suggest that some modification of the theory is required. (auth)

10181 MODEL EXPERIMENT FOR THE INTERACTION OF SOLAR PLASMA STREAM AND GEOMAGNETIC FIELD. Nobuki Kawashima (Japan Atomic Energy Research Inst., Tokyo) and Naoshi Fukushima. Planetary Space Sci., 12: 1187-1201(Dec. 1964).

A laboratory experiment was designed to study the interaction of the solar wind with the geomagnetic field. Time-exposure and time-resolved photographs were taken when plasma hit a model earth, and direct measurements were made of the magnetic field change, plasma density, and electric current distribution. The shape of the magnetic cavity formed on the upstream side of the model earth was almost the same as that calculated for the geomagnetic cavity. The charged particles, which penetrated the magnetic cavity formed on the upstream side of the model earth with east–west asymmetry from the neutral points on the cavity surface, appeared to concentrate towards the equator on the rear side of the model, forming a westward electric current belt within the magnetosphere. When the dipole axis was not perpendicular to the plasma gun— magnetic dipole line, the invasion of plasma was more pronounced at the cusp of the cavity nearer to the gun. Charged particles appeared to penetrate to a greater extent if a uniform external magnetic field was applied parallel to the magnetic dipole than if one was applied antiparallel. (auth)

10182 ISOTOPES IN RELATION TO POLAR GLACIOLOGY. C. Lorius (Université, Paris). Polar Record, 12: 211-28(1964).

Isotopic applications in glaciological studies are discussed. It is noted that the Antarctic ice sheet provides an area of storage of cosmic and terrestrial deposits falling on the earth during recent geological time. The lines of research in isotopic glaciology are presented diagrammatically. (J.R.D.)

10183 GEOMAGNETIC DISTURBANCE ACCOMPANYING THE HIGH ALTITUDE NUCLEAR DETONATION AT JOHNSTON ISLAND ON JULY 9TH, 1962. Yoshio Kato and Shigeo Takei (Tohoku Univ., Sendai). Sci. Rept. Tohoku Univ., Fifth Ser., 15: 7-32(May 1963).

The propagation of the isotropic mode of the hydromagnetic waves in the magnetosphere was analyzed and the travel-time curve of that wave emitted from various sources was calculated and compared with the time of commencement of the geomagnetic disturbance accompanying the high altitude nuclear detonation at Johnston Island on July 9th, 1962. It was concluded that since the observed delay time was too short, the mechanism of magnetic transient variations produced by this high altitude nuclear detonation is not simply explained. (auth)

10184 FURTHER NOTES ON "GEOMAGNETIC DISTURBANCE ACCOMPANYING THE HIGH ALTITUDE

NUCLEAR DETONATION AT JOHNSTON ISLAND ON JULY 9TH, 1962." Yoshio Kato and Shigeo Takei (Tohoku Univ., Sendai). Sci. Rept. Tohoku Univ., Fifth Ser., 15: 77-82(Mar. 1964).

In another paper the geomagnetic disturbance accompanying the high altitude nuclear detonation at Johnston Island on July 9th, 1962, was examined and it was concluded that the first impulses appearing on the magnetograms were not considered as the arrivals of the hydromagnetic space waves radiated from the source region of the detonation. Re-examination of these geomagnetic records revealed that the travel time-distance curve of the second phases of the disturbance had good agreement with the theoretical curve. (auth)

10185 THE ALLOWED REGIONS OF CHARGED PARTICLES MOVING IN THE MAGNETIC FIELD AND THE MODEL EXPERIMENT. Yung-lan Shu and Guo-cheng Chou. Ti ch'iu Wu Li Hsueh Pao, 12: 121-30(1963).

The allowed regions of a single charged particle moving in the various fields of force were investigated. Assuming that the magnetic field has a potential, two types of assumed magnetic potential were considered: the magnetic potential is axial symmetric; and the magnetic potential is a two dimensional function. The result of the calculation shows that the boundary of the allowed regions is similar to the magnetic lines when special condition is fulfilled, and the allowed regions can be studied from the figure of the magnetic line. The results of calculation were also compared with the model experiment, in which glow regions in the gaseous discharge correspond to the allowed regions and the dark regions correspond to the forbidden regions. In the terrella experiment, the glow was trapped in the dipole field, when the magnetic moment of the terrella was greater than a critical value. When the dipole field was disturbed by a uniform field which is antiparallel to the dipole field at the equatorial plane, or a field originated from a ring current situated outside the trapped region at the equatorial plane; the dipole magnetic lines are stretched and expanded, and the glow will also be extended. The variation of the boundary of the glow is similar to that of the magnetic lines. In the gaseous discharge experiment around the neutral line in the magnetic field, the boundary of the glow is also similar to the magnetic lines. Since many phenomena in gaseous discharge are very complicated, it was very difficult to compare the result of calculation with the experiment quantitatively, therefore some simplified assumptions were introduced and the boundary of the glow regions was calculated. The result was in good agreement with the experiment. (Sci. Abstr. China, Earth Sci., 2: No. 2, 1964)

10186 THE ULTRA SOFT ELECTRONIC COMPONENT OF THE ENVIRONMENTAL RADIATION. Joseph G. Reisinger. Thesis, New York, New York Univ., 1964. 91p.

A detector capable of separating the low energy ionizing radiation from the non-ionizing component of the environmental radiation was developed. The detector consists of a very thin-walled continuous flow proportional counter in coincidence with a NaI scintillation spectrometer. This detector was employed to evaluate the intensity and spectral distribution of the electronic component of the environmental radiation from 130 kev to 3.6 Mev. By adding various thicknesses of aluminum above the detector assembly, it was possible to further divide the electronic component into its equilibrium and non-equilibrium subcomponents. Evaluation of the beta activity due to the decay products of radon, normally present in the atmosphere, indicates that the non-equilibrium component may be attributed primarily to this source. The measurements were made 170 feet above sea level, on the roof of the main building of New York University at Washington Square. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10187 ON SOME NON-LINEAR PHENOMENA IN THE IONOSPHERIC PLASMA. P. Caldirola and O. De Barbieri (Università, Milan). 57p. (CONF-630-4)

From Conference on Non-Linear Processes in the Ionosphere, Boulder, Colo., Dec. 1963.

A study of the nonlinear propagation of electromagnetic waves in plasma is presented. The distribution function of the electrons of a slightly ionized plasma under the influence of an external magnetic field and of an e.m. wave of the type $E = E_0 \cos \omega t$ is calculated and discussed. Taking into account the elastic and inelastic collisions between electrons and molecules, the mean electronic energy due only to the absorption of the extraordinary wave of the electric field and its maximum are calculated. The study of the effects of inelastic collisions shows that in order to have an equal electronic temperature the intensity of the electric field must be about 5 times greater than that for elastic collisions only. For the same type e.m. wave the components of the complex dielectric permittivity tensor are shown to be dependent on E_0. A nonlinear dispersion relation is calculated which shows that in the nonlinear case the electric field is split into two components whose propagation is never independent. Also calculated and studied are the electronic distribution function and the complex dielectric permittivity tensor for a wave of the type $E = E_0 [1 + \eta \cos (\alpha t + \beta)] \cos \omega t$ with $\omega \simeq \omega_H \gg \alpha$. (H.D.R.)

10188 USE OF RADIO TRANSMITTERS TO DECREASE D-REGION ELECTRON DENSITY. Paul Molmud (TRW/Space Technology Labs., Redondo Beach, Calif.). 87p. (CONF-630-5)

From Conference on Non-Linear Processes in the Ionosphere, Boulder, Colo., Dec. 1963.

A study is made of a method of decreasing the electron density in the D-region. The method involves the heating of electrons by intense electromagnetic radiation. This increases the electron attachment rate and thereby decreases the electron density. The relevant D-layer rate processes are reviewed and incorporated into a detailed analysis of the influence of a perturbing electromagnetic pulse upon the variation in time of the electron density. The theory of conductivity of a weakly ionized gas is reviewed and augmented to include dependency on field strength. Propagation constants are determined and the equations describing the nonlinear radial propagation of a powerful wave in a weakly ionized inhomogeneous medium are derived. Numerical solutions of these equations are obtained which describe the effects due to the vertical propagation of waves for several power levels and frequencies through a heavily perturbed D-region. It is found that the powerful wave modifies the electron density distribution. The combination of high frequency and optimum power level provides a channel of decreased electron density in the D-region through which a wave may propagate with greatly reduced attenuation. (auth)

Low Temperature Physics

Refer also to abstracts 9460 and 10449.

10189 (RLE-TR-427) DEVELOPMENT OF A LARGE-VOLUME SUPERCONDUCTING SOLENOID (thesis). Lucien J. Donadieu (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Oct. 16, 1964. Contract DA36-039-AMC-03200(E). 131p. (AD-608445).

Problems encountered in the development of large-volume superconducting solenoids have been investigated in the light of the experience induced by the realization of a particular prototype (8.0 inches in diameter, 4 ft long, 20 kilogauss at room temperature). The current-field characteristics of some superconducting materials (Nb, Mo–Re, and Nb–Zr) have been measured; the results are discussed in terms of theories of superconductors. Electrical connections are very important in superconducting circuits, and hence received detailed treatment. The spurious loss of the resistanceless state of a superconducting solenoid, which is particularly dangerous for large-volume devices, because of the large magnetic energy involved, was investigated. Starting from the steady-state mechanisms of the quenching propagation in wire, the equations for current decay, voltage surge, wire-temperature rise, and energy transfer are derived; results of calculations for the prototype solenoid are presented. The design of the prototype solenoid, which can be divided somewhat arbitrarily into the magnetic-field generating system and the cryogenic system, is detailed. The most important topics covered are: field calculation for multicoil solenoids (a machine program to calculate the field on- and off-axis is presented); magnetic stresses and magnetic energy; quenching process for multicoil solenoids; steady-state heat transfer caused by residual gas, thermal radiation and conduction (a derivation of the conduction loss with counterflow gas cooling is presented); and transient heat transfer, particularly during cooling down and quenching. (auth)

10190 PHONONS IN LIQUID HELIUM. Kerson Huang (Massachusetts Inst. of Tech., Cambridge) and Abraham Klein. Ann. Phys. (N. Y.), 30: 203-34(Nov. 1964). (MIT-2098-47)

By writing a dispersion relation for the density propagation function the most general form of the function consistent with known sum rules is obtained for any macroscopic system of bosons or fermions. The Fourier transform of the pair correlation S_k appears explicitly in the dispersion relation. An inequality for S_k is derived for any macroscopic system. The results are specialized to liquid ^{4}He by making the single assumption that for $k \rightarrow 0$, S_k saturates the inequality. This assumption is consistent with experiments and is proved by assuming Bose-Einstein condensation and by making essential use of the gauge invariance associated with the conservation particles. The nature of the low-lying excited states of ^{4}He can then be deduced. It is found that for given small momentum k, there is a group of states having an energy distribution peaked about ck, with a Lorentzian shape. The constant c is the velocity of sound at absolute zero, defined in terms of the macroscopic compressibility. The wave functions of these states are in some average sense Feynman's phonon wave function. (auth)

10191 THE INTERMEDIATE STATE OF SOME SUPERCONDUCTORS. W. De Sorbo and W. A. Healy (General Electric Research Labs., Schenectady, N. Y.). Cryogenics, 4: 257-326(Oct. 1964).

Descriptions of magnetic field penetration, steady state patterns, and magnetic flux annealing in some superconductors are summarized. The descriptions are essentially photographic records obtained with an improved technique, employing magneto-optic rotation (Faraday effect) in a transparent paramagnetic material, cerous phosphate glass. Studies are reported on tin, tin films, dilute tin–indium alloys, lead, tantalum, and type II superconductors: niobium–tantalum alloy and lead–indium alloy. 55 references. (auth)

10192 EFFECTS OF MAGNETIC FIELD ON THE ULTRASONIC ATTENUATION IN SUPERCONDUCTING NIOBIUM. Akira Ikushima (Osaka Univ.), Taira Suzuki, Nobuo Tanaka, and Sadao Nakajima. J. Phys. Soc. Japan, 19: 2235(Nov. 1964).

Ultrasonic attenuation in superconducting niobium was measured by the pulse-echo method using the longitudinal wave of 35 Mc propagating along the specimen axis. The magnetic field was applied in the same direction. The relative attenuation of the superconducting state to the normal state, plotted against magnetic field, begins to increase slowly from a certain field strength and reaches unity rapidly at some higher field. These two critical fields were found to coincide with the initial penetration field and the upper transition field, respectively. The permeability was measured for the specimen as a function of magnetic field, and the magnetization was obtained by integration. (C.E.S.)

10193 ON SURFACE SUPERCONDUCTIVITY IN LEAD. L. J. Challis (Nottingham Univ., Eng.). Phys. Letters, 13: 20-1(Nov. 1, 1964).

The results of several previous experiments indicate the presence of a layer on the surface of lead that remains superconducting in fields greater than H_c. The predictions of surface superconductivity suggest that if the Kapitza resistance, κ, is greater than 0.42, surface superconductivity remains to a field $H_{c3} > H_{c2}$ or, for a type I superconductor, $H_{c3} > H_c$. The extent to which κ can vary for a lead surface is discussed, and it is shown that the experimental results indicate that there is no superconductivity at a clean lead surface. (C.E.S.)

10194 NMR MEASUREMENTS OF THE FLUX DISTRIBUTION IN TYPE II SUPERCONDUCTORS. P. Pincus (Univ. of California, Los Angeles), A. C. Gossard, V. Jaccarino, and J. H. Wernick. Phys. Letters, 13: 21-2(Nov. 1, 1964).

The penetration of flux in type II superconductors in high magnetic fields was studied by NMR techniques. NMR measurements on ^{51}V in V_3Si and V_3Ga, which determine both the mean flux and the spatial distribution of the flux in the superconducting mixed state, were made. The experiments were performed in fields of 7 to 14 kOe where the spacing between the flux filaments of the Abrikosov state should be of the order of 500 Å, which is much larger than the internuclear distance of 2.36 Å. Thus the nuclei are on a fine enough grid to investigate the consequences of a filamentary flux structure. A comparison of the intensities of the observed resonance absorptions in the normal and superconducting states indicate that essentially all of the nuclei in the samples measured were contributing to the resonances below T_c. (C.E.S.)

10195 TEMPERATURE DEPENDENCE OF THE GINZBURG-LANDAU PARAMETER κ IN WEAK AND STRONG COUPLING SUPERCONDUCTORS. B. Rosenblum and M. Cardona (RCA Labs., Princeton, N. J.). Phys. Letters, 13: 33-4(Nov. 1, 1964).

The Ginzburg-Landau parameter κ was measured for several weak and strong coupling superconductors as a function of temperature and impurity content. For fairly pure strong coupling superconductors the fractional variation of κ with temperature is much larger than for weak coupling superconductors or less pure strong coupling superconductors. The large temperature dependence is believed to be due to quasi-particle damping which causes an increase in the increasing coherence distance ξ_0 with temperature thus decreasing κ. (C.E.S.)

10196 A SMALL SIZE SUPERCONDUCTING DYNAMO POWERED BY AC CURRENT. B. S. Blaisse, O. Kichert, G. J. C. Bots, and L. A. Sipman (Technische Hogeschool, Delft, Netherlands). Phys. Letters, 14: 5(Jan. 1, 1965).

A small superconducting dynamo that operates with the help of a 3-phase current in combination with a d-c current is described. The dynamo consists of two symmetrical parts. The annular part of the yoke was made of laminated iron. The coils for generating the 3-phase field are situated in 12 slots in each of the two annular parts. The coils for the d-c field are fixed around the central bar of the yoke. All the coils are made of copper. A Nb foil lies in the slit between the two parts of the dynamo. A Nb–Zr wire is used to connect the inner edge of the Nb foil to the superconducting solenoid. (C.E.S.)

10197 EFFECT OF MANGANESE ON THE MAGNETORESISTIVE PROPERTIES OF SUPERCONDUCTING INDIUM. F. T. Hedgcock (McGill Univ., Montreal) and W. B. Muir. Phys. Letters, 14: 11-13(Jan. 1, 1965).

Experiments were carried out to determine the magnetic nature of the interaction in the In–Mn alloy, if present, and to investigate whether a resonance spin scattering of the superconducting electrons occurred at low temperatures. In order to determine whether the resonance scattering is present the electric conductivity was measured as a function of temperature in a small magnetic field and the magnetoresistance determined as a function of field at the temperature of liquid helium. (C.E.S.)

10198 SUPERCONDUCTIVITY OF ANTIMONY. T. R. R. McDonald (Air Reduction Co., Inc., Murray Hill, N. J.), E. Gregory, G. S. Barberich, D. B. McWhan, T. H. Geballe, and G. W. Hull, Jr. Phys. Letters, 14: 16-17 (Jan. 1, 1965).

Superconductivity was observed in a phase of elemental antimony retained upon the release of high pressure at 77°K. The superconducting transition occurs between 2.6 and 2.7°K. (C.E.S.)

10199 ACOUSTIC IMPEDANCE OF LIQUID He^3. J. Gavoret (Univ. of Illinois, Urbana). Phys. Rev., 137: A721-3(Feb. 1, 1965).

A derivation of the acoustic impedance of liquid ^{3}He at very low temperatures, where the behavior of the liquid is of the collisionless type, is presented. Assuming the collective mode is dominant, it is shown that the energy transfer at the boundary can be calculated directly by equating the work done by the vibrating wall against the pressure of the liquid to the energy flowing from the wall in the collective mode. The comparison of the result with the exact result obtained by Bekarevich and Khalatnikov demonstrates the accuracy of the method. The application to experiment is discussed. (auth)

10200 LOW-TEMPERATURE HEAT CAPACITIES OF INDIUM AND TIN. H. R. O'Neal and Norman E. Phillips (Univ. of California, Berkeley). Phys. Rev., 137: A748-59 (Feb. 1, 1965). (UCRL-10426(Rev.1))

The heat capacity of indium was measured between 0.08 and 4.2°K in the normal state (H = 1000 Oe) and between 0.1°K and the critical temperature in the superconducting state. At $T \leq 0.8$°K, $C_n = 0.00101T^{-2} + 1.69T + 1.42T^3$ mJ mole^{-1} deg^{-1} and at $T \leq 0.35$°K, $C_s = 1.22T^3$ mJ mole^{-1} deg^{-1}. The absence of the hyperfine contribution to C_s is a consequence of the long spin-lattice relaxation time. Below 0.35°K, where the superconducting-state lattice heat capacity can be measured, the normal-state lattice heat capacity is only a small part of C_n and calorimetric measurements alone cannot exclude the possibility that the lattice heat capacities in the two states are equal. However, the excellent agreement between the elastic constants and the apparent normal-state lattice heat capacity supports the conclusion that they are not. The apparent discrepancy in the lattice heat capacities is less than that reported by Bryant and Keesom but the difference is largely accounted for by differences in analysis of the normal-state data and by their assumption that the measured C_s included the nuclear quadrupole term. The measurements of C_s extend to temperatures well below that at which the electronic contribution becomes negligible and therefore permit a comparison with theoretical studies of the superconducting-state lattice heat capacity. The heat capacity of tin was measured only below 1°K. Below 0.45°K, $C_s = 0.246T^3$ mJ mole^{-1} deg^{-1}, in good agreement with the elastic constants. Within the experimental error, $C_n = 1.78T + 0.246T^3$ mJ mole^{-1} deg^{-1}. (auth)

10201 TUNNELING DENSITY OF STATES FOR A SUPERCONDUCTOR CARRYING A CURRENT. Peter Fulde (Univ. of Maryland, College Park). Phys. Rev., 137: A783-7(Feb. 1, 1965).

A current flowing in a superconducting film has a tendency to break pairs similar to the effect of paramagnetic impurities in a superconductor. The effect of the current on the tunneling density of states for a normal-superconducting tunneling junction was computed by the Green's-function method of Abrikosov, Gorkov, and Maki, and found to be identical (for a short mean free path) to that of paramagnetic impurities. A simple relation between the current parallel to the junction and the equivalent paramagnetic-impurity concentration is derived. Passing various amounts of current through the sample in the one experiment gives the same information as is obtainable in the other experiment only by preparing different samples with various impurity concentrations. (auth)

10202 OFF-DIAGONAL LONG-RANGE ORDER AND PERSISTENT CURRENTS IN A HOLLOW CYLINDER. F. Bloch (Stanford Univ., Calif.). Phys. Rev., 137: A787-95 (Feb. 1, 1965).

Some properties of the reduced density matrix are considered in their general relation to the current produced by a system of charged particles in a thin-walled long cylinder. The common connection of persistent currents and off-diagonal long-range order to the velocity distribution function will be particularly stressed. Essential features of this function, characteristic for the superconducting state, are discussed and exemplified by applying an analogous procedure to the case of boson and fermion systems. (auth)

10203 EXPERIMENTAL STUDY OF THE DECAY OF PERSISTENT CURRENTS IN A SOFT SUPERCONDUCTING RING UNDER α-PARTICLE IRRADIATION. N. Sacchetti, G. Sacerdoti, G. Sanna, F. Smriglio, and A. Susanna (Comitato Nazionale per l'Energia Nucleare, Frascati, Italy). Phys. Rev., 137: A796-800(Feb. 1, 1965). (LNF-64/35)

In a previous experiment, it was observed that the persistent current in a thin Pb superconducting ring decays when the material is subjected to α-particle irradiation from a ^{210}Po source. Systematic observations of flux decay were carried out under different experimental conditions. The effects of varying the temperature (from 1.1 to 4.2°K), the thickness of superconducting layers (from about 10 to 40 μ), and the materials (lead, tin, and indium) were investigated. The flux decay law deduced from the experimental data seems to be logarithmic in time, showing a behavior similar to that observed by Kim et al., for flux creep in hard superconductors. (auth)

10204 SURFACE EFFECTS IN THE MIXED SUPERCONDUCTING STATE. P. S. Swartz and H. R. Hart, Jr. (General Electric Research Lab., Schenectady, N. Y.). Phys. Rev., 137: A818-28(Feb. 1, 1965).

Measurements of the critical transport current above H_{c1} in a variety of $Pb_{0.95}$ $Tl_{0.05}$ samples reveal that the surface can support a large transport current in the mixed state when the magnetic field vector is aligned with the surface. When a geometry is chosen so that the magnetic field vector can be aligned with a single surface (e.g., a cylinder of triangular cross section), the critical currents of opposite polarities differ by over a factor of 3 when the magnetic field vector is parallel to a surface plane; partial rectification is thus observed. The larger critical current is always in a direction that indicates that magnetic flux crosses out of the surface of a type-II superconductor more easily than into the surface. The anomalous peak effect (a maximum in the critical current just below H_{c2}) is observed in annealed samples and is identified with the strength of the Saint-James-de Gennes surface film below H_{c2} because of the manner in which it is affected by a thin surface film of copper. The critical-transport-current results suggest that two separate mechanisms contribute to the surface transport current in the mixed state. One of these mechanisms is identified with the Saint-James-de Gennes surface film below H_{c2}; the second is tentatively associated with a bulk penetration depth. A mixed-state resistivity was measured, and the contributions from the surface and the bulk were separated. The bulk mixed-state resistivity is found to be independent of the density of bulk defects. (auth)

10205 FLUX QUANTIZATION AND GENERALIZED PAIRING IN SUPERCONDUCTING CYLINDERS. Brian B. Schwartz and Leon N. Cooper (Brown Univ., Providence). Phys. Rev., 137: A829-41(Feb. 1, 1965).

The observation that flux is quantized in units of ch/2e in multiply connected superconductors can be understood if the paired electrons in the ground-state wave function have identical angular momentum. It is possible, however, to generalize the pairing condition and obtain a superconductor in which the ground-state paired electrons have different momentum. Under these circumstances, the relation between superconductivity and flux quantization is obscured and the question is reinvestigated. The Gibbs free-energy per unit volume of the superconductor can be separated into three parts: A magnetic term which is a minimum when the external and internal fields are equal; a kinetic term, which after suitable averaging is found to be independent of the enclosed flux; and the superconducting correlation energy, which is periodic in the enclosed flux, with minima at integral multiples of ch/2e. The result that flux quantization in units of ch/2e occurs when the minima of the correlation energy at integral flux values determine the behavior of the free energy is obtained, and this is the usual case. By choosing an appropriate sample (one which is not rotationally invariant and in which the inner hole is very small), the magnetic energy might be made to dominate in the Gibbs function. Then one would expect a breakdown of quantization, with the flux approaching that due to the external field. Nonintegral flux values would correspond to states of mixed pairing. (auth)

10206 BEHAVIOR OF FIRST- AND SECOND-KIND SUPER-CONDUCTING FILMS NEAR THEIR CRITICAL FIELDS. J. P. Burger, G. Deutscher, E. Guyon, and A. Martinet (Faculte des Sciences, Orsay, France). Phys. Rev., 137: A853-9(Feb. 1, 1965).

The upper critical magnetic field of thin superconducting films was studied as a function of its orientation with respect to the surface of the sample and as a function of the film thickness compared with $\lambda(T)$ and $\xi(T)$, for second-kind (Sn-In, In-Pb, Pb-Bi) and first-kind (Sn) materials. The results were obtained by resistivity, dynamic-susceptibility, penetration-depth, and tunneling measurements. (auth)

10207 TUNNELING MEASUREMENTS OF PHONON SPECTRA AND DENSITY OF STATES IN SUPERCONDUCTORS. J. M. Rowell and L. Kopf (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 137: A907-16(Feb. 1, 1965).

Using the technique of electron tunneling between superconducting films, the density-of-states variation with energy in a number of soft superconductors was measured. In lead it is shown that the density-of-states variation suggests the form of the phonon spectrum which is effective in the coupling of the Cooper pairs. The spectrum has transverse and longitudinal peaks located at 4.4 and 8.5 Mev, respectively. A solution of the Eliashberg gap equation using this phonon spectrum and reasonable values for coupling constants gives good agreement between theoretical and experimental density-of-states plots, as shown by Schrieffer et al. In addition of the density-of-states variation due to the two main peaks in phonon density, fine structure which is the effect of the Van Hove critical points in the phonon spectrum is resolved. Reasonable agreement is found between the energy and type of structure observed in the density-of-states variation and the occurrence of critical points in the dispersion curves obtained by neutron scattering. From similar experiments it is suggested that the tin phonon spectrum extends to 17.7 Mev with critical points as low as 3.4 Mev. In indium the end of the spectrum appears to be 14.8 mev with a transverse peak between 3 and 7 Mev and a longitudinal peak from 11 to 14 Mev. (auth)

10208 DEVICE FOR MEASURING ELECTROMAGNETIC FORCES IN SUPERCONDUCTING MAGNETIC SUPPORTS. I. D. Kolodeev and A. I. Sudovtsov (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Pribory i Tekhn. Eksperim., No. 5, 182-4(Sept.-Oct. 1964). (In Russian)

Descriptions are given of a device for measuring electromagnetic repulsion forces in superconducting magnet supports. The measurements are carried out with a zero dynamometer with simultaneous recording of the force and gap magnitudes. (tr-auth)

10209 THEORY OF SUPERCONDUCTIVITY IN FERROMAGNETS. Hang-shen Wu. Wu Li Hsueh Pao, 19: 103-14(1963).

The influence of internal magnetic field on the superconductive characteristics in a ferromagnetic material was investigated. It was found that on the ground state of a ferromagnetic superconductor, the electrons are coupled in pairs, and BCS theory may be applied to these cases. The internal magnetic field exercises destructive function to the superconductive characteristics, so that the superconductive phase can exist only if the internal magnetic field Δ is smaller than a certain critical value Δc, which decreases with the increase of temperature. Due to the presence of internal magnetic field, the superconductivity-normality phase transformation in the ferromagnetic superconduction is of the first order; the value of critical temperature Tc and of the critical magnetic field Hc are lower than that in the case without the existence of internal field. Finally, it is pointed out that the superconductive characteristics of ferromagnets are similar to those of non-ferromagnetic superconductors in an external magnetic field. (Sci. Abstr. China, Math. Phys. Sci., No. 4, 1963)

10210 EFFECT OF A MAGNETIC FIELD ON MICROWAVE ABSORPTION AND THE ENERGY GAP IN SUPERCONDUCTING FILMS. Ray Henry White. Thesis, Berkeley, Calif., Univ. of California, 1964. 74p.

The change in absorption of microwave radiation in superconducting indium, tin, and lead films was measured as a function of magnetic field. Experiments were conducted on films 145–700 Å thick using 8-mm and 4-mm wavelength microwave radiation, primarily with the magnetic field parallel to the plane of the film, but also as a function of angle between the magnetic field and the plane of the film. A second order phase change in the magnetic field was observed as is to be expected for films of this thickness according to the theories of Ginzburg and Landau and of Nambu and Tuan. The angular dependence of the critical field was in good agreement with the theory of Tinkham. An attempt was made to infer the magnetic field dependence of the energy gap, Δ, from our absorption measurements in a parallel magnetic field. Initially it was assumed that the effect of a magnetic field could be adequately described by a dependence of Δ on magnetic field. With this assumption Δ was inferred as a function of H from absorption measurements by using the calculations of Miller, based on the theory of Mattis and Bardeen. The magnetic field dependence of Δ found was not in agreement with previous experiment and theory; as Δ decreased more rapidly in low magnetic fields in these experiments, nor is it consistent for the two frequencies used. Thus it appears that the experimental absorption measurements cannot be adequately described by a single field dependent gap parameter. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10211 MICROWAVE MAGNETO-IMPEDANCE OF SUPERCONDUCTING TIN. Robert Taber Lewis. Thesis, Berkeley, Calif., Univ. of California, 1964. 59p.

Measurements, using a bimodal cavity, of the temperature and magnetic field dependence of the surface impedance of a single crystal of superconducting tin at a frequency of 23.5 gc/sec are reported. In the geometry used, the static and microwave magnetic fields were parallel over the surface of the sample. The temperature dependence of the reactance in zero field agrees well with that calculated by Miller from the BCS theory. A small unexpected knee in the temperature dependence of the resistance is observed, centered around a reduced temperature of $t = 0.88$. This knee may arise from a band of p electrons with a smaller energy gap whose temperature dependence differs markedly from the BCS form, as proposed by Suhl, Matthias, and Walker. The change of surface resistance with applied field is found to be negative in the temperature range of the knee with the greatest negative dependence occurring at the center of the knee. The change of resistance is found to be positive outside this temperature range. The change of reactance with field is found to be positive. The association of the negative field dependence of the surface impedance with a band of p electrons is shown to give a qualitative explanation of the field dependence as observed in this and other investigations. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10212 FOURTH SOUND IN HELIUM II. Kenneth Abraham Shapiro. Thesis, Los Angeles, Univ. of California, 1964. 54p.

Fourth sound is a pressure and density wave in helium II, in which only the superfluid is in motion. The existence of this wave mode was substantiated experimentally by measuring the frequency of a plane wave resonance in a closed-closed cylindrical acoustic resonator, as a function of the absolute temperature. The resonator was filled with a porous medium, which allowed only superfluid motion. The velocity values derived from the frequency data agree to 1% with the temperature dependence predicted theoretically. The absolute value of the fourth sound velocity is affected by the coherent multiple scattering of the wave from the superleak material. An empirically determined correction predicts the effect of multiple scattering, as a function of superleak porosity, to 3%. The theoretical multiple scattering formulas yield results correct in sign but not in magnitude. Values of the ratio of the superfluid to the helium II density derived from the fourth sound data corrected for multiple scattering effects agree to 2% with those gathered by other experimental techniques, and afford greater temperature resolution than obtained previously. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10213 SUPERCONDUCTIVITY. John Bardeen. p.VII-36 of "1962 Cargèse Lectures in Theoretical Physics." New York, W. A. Benjamin, Inc., 1963.

Developments leading to the present microscopic theory of superconductivity are reviewed; and the normal configurations, the nature of the wave function, and elementary excitation in superconductors are discussed. The integral equation for the energy gap is developed using the equation of motion method, the Bogoliubov and Eliashberg approach, the BCS method, and Green's functions. Transition probabilities, coherence effects, the two-fluid model, and flux quantization are also discussed. (L.B.S.)

10214 ANOMALIES IN THE SUPERCONDUCTING TRANSITION OF H.C.P. Ti ALLOYS. E. Bucher, F. Heiniger, and J. Müller (Université, Geneva). 13p. (CONF-651-37)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

Calorimetric and magnetic measurements were made on a series of dilute Ti alloys with V, Cr, Mn, Fe, Zr, Nb, Mo, Ru, W, and Re. Observed specific heats and superconducting transitions indicated that the series of alloys, although undergoing a complete diamagnetic transition, exhibit a reduced calorimetric anomaly. The superconducting behavior of some of the specific alloys was also analyzed. (H.D.R.)

10215 TRAINING IN SUPERCONDUCTING SOLENOIDS. M. S. Lubell and G. T. Mallick (Westinghouse Electric Corp., Pittsburgh). 11p. (CONF-543-14)

From American Physical Society 1964 March Meeting, Philadelphia, Mar. 1964.

A method is described for inducing and annihilating training in small superconducting solenoids which by themselves do not exhibit training. Solenoid training is shown to depend on magnetic properties of the wire, which in this study is 0.025-cm diameter Nb-45% Ti and 0.025-cm diameter Nb-25% Zr. Another method, termed self-training, is described for inducing training without the use of an external field cycle. (H.D.R.)

10216 SUPERCONDUCTING BEHAVIOR OF INDIUM LEAD ALLOYS. S. Gygax (Eidgenossische Technische Hochschule, Zurich), J. L. Olsen, and R. H. Kropschot. 6p. (CONF-651-39)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

The magnetic and resistive superconducting transitions are measured on bulk samples of In–Pb alloys in the α phase region. Results are interpreted within the framework of the GLAG theory. The critical field and temperature are obtained, and the specific heat constant is computed. (H.D.R.)

Neutron Physics

Refer also to abstract 10510.

10217 (BNL-8711) A PROGRAM FOR STRENGTH FUNCTION ANALYSIS. R. E. Chrien (Brookhaven National Lab., Upton, N. Y.). Dec. 1964. Contract AT-30-2-GEN-16. 7p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A FORTRAN 7094 program was written to analyze low-resolution neutron transmission data for S-wave neutron strength functions, $\langle\Gamma_n^0\rangle/D$. The strength function is derived from the slope of the transmission as a function of neutron time-of-flight in the kilovolt energy region where the chopper does not, in general, resolve individual resonances. Since many levels are included in the averaging process, and individual parameters need not be determined, the inherent accuracy of the method is high. (auth)

10218 (CEA-Note-461) ETUDE SUR LES ACCELERATEURS DE PARTICULES DU TYPE TRANSPORTABLE UTILISES EN TANT QUE SOURCES DE NEUTRONS. RAPPORT 7. 9. CARACTÉRISTIQUES DES ACCÉLÉRATEURS ACTUELLEMENT SUR LE MARCHÉ. (Study on Particle Accelerators of Transportable Type Utilized as Neutron Sources. Report 7. 9. Characteristics of Accelerators Now on the Market). Serge Godar (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Aug. 1964. 88p. Dep.(mn).

Data on commercially available portable particle accelerators that can be used as neutron sources are tabulated. (J.S.R.)

10219 (CONF-654-24) A METHOD OF AVERAGING DIFFUSION COEFFICIENTS. P. A. Ombrellaro and P. J. von Herrmann (Knolls Atomic Power Lab., Schenectady, N. Y.). Nov. 1964. Contract [W-31-109-eng-52]. 13p.

From American Nuclear Society Meeting, San Francisco, Nov.-Dec. 1964. Dep.(mn); $1.00(cy), 1(mn) OTS.

Considering the neutron diffusion matrix as a tensor, a method is shown for obtaining the few-group off-diagonal matrix elements, by coalescing the many-group space energy problem results. The results of applying the infinite-medium diffusion tensor to few-group space energy calculations are also noted. (T.F.H.)

10220 (GEMP-329) PROGRAM FLUXWT (NMP-800)—A FLUX WEIGHTING PROGRAM. W. B. Henderson (General Electric Co. Advanced Technology Services, Cincinnati). Oct. 5, 1964. Contract AT(40-1)-2847. 58p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Program FLUXWT calculates flux-weighted multigroup values of input point-valued data. A coarse input lattice of point-valued cross sections and corresponding energies in ascending or descending order is expanded by interpolation to a fine energy mesh for improved integration accuracy. Fluxes in the coarse input lattice may be read in, or the program will generate a flux distribution having a fission spectrum distribution at high energies, a $1/E^x$ distribution at intermediate energies, and a Maxwellian distribution below a thermal cutoff. Input is limited to 1000 lattice point values. The principal output consists of multigroup flux-weighted cross sections and the corresponding multigroup fluxes over specified energy intervals numbering no more than 500. The source language is FORTRAN II with the exception of one input processing subroutine, DING, which is in FAP language and is not in the FORTRAN library. The source listings of all subroutines except library subroutines are included. (auth)

10221 (GNE/PHYS/64-7) THEORETICAL CALCULATION OF NEUTRON AGE (thesis). Robert Hans Hansen (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1964. 127p. (AD-603603). $4.00(OTS).

A method is described for computation of neutron age to the indium resonance in arbitrary mixtures of nuclides. Ages of fission neutrons in a wide variety of modulators were calculated. The method is the Fourier transformed moments solution of the Boltzmann equation, evaluated with multigroup techniques. Initially, the evaluation was for 68 groups; however, the number of groups was systematically reduced until an eleven-group set was selected as a reasonable compromise between accuracy and ease of computation. The program not only computes group ages, but also provides a slowing-down spectrum of average group fluxes per unit lethargy versus lethargy. Combined with a cross section averaging subroutine, this code could provide all required fast constants for a few group reactor physics problem. The final code will handle any number of groups up to twenty. Input data for any one problem is minimal, the main portion of the input consists of a punched card cross section library. It is an economic, simple to execute, versatile code, which meets the engineering accuracy criteria initially postulated. (auth)

10222 (UCRL-12128) ON THE ACCURACY OF DIFFUSION THEORY FOR NEUTRON MODERATION. J. R. Terrall (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 1964. Contract W-7405-eng-48. 26p. Dep.; $2.00(OTS).

In an attempt to retain the relative simplicity of diffusion theory—or rather the form of diffusion theory—and the wealth of analytical and numerical methods that has grown out of it, corrections are investigated that bring it closer to a true transport theory. This inquiry is based on the linear Boltzmann equation with arbitrary scattering kernels (inelastic as well as elastic). (auth)

10223 (WAPD-T-1734) THE USE OF CORRELATED SAMPLING IN MONTE CARLO CALCULATION OF CHANGES IN THERMAL ABSORPTION. N. J. Curlee, Jr., and L. A. Ondis, II (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1964. Contract AT-11-1-GEN-14. 12p. (CONF-654-30). Dep.(mn); $1.00(cy), 1(mn) OTS.

From American Nuclear Society Meeting, San Francisco, Nov.-Dec. 1964.

The method of correlated sampling is applied to the problem of calculating changes in thermal absorption rates due to small physical perturbations. Improvements in running time of Monte Carlo transport theory calculations have been obtained. (auth)

10224 A NEW FORMULATION OF THE MULTIGROUP DIFFUSION THEORY. Ferdinand Cap (Univ. of Innsbruck). Acta Phys. Austriaca, 19: 1-4(1964).

The general transport equation is used to derive noncoupled diffusion equations for neutrons in reactors. An iteration process is described, allowing any desired accuracy to be obtained, while the usual multigroup theory is restricted to the accuracy of the Fermi age theory. (M.J.T.)

10225 ON DETERMINATION OF THE TIME-DEPENDENT PAIR CORRELATION FUNCTION FROM INELASTIC SCATTERING MEASUREMENTS OF SLOW NEUTRONS AT A FIXED ANGLE. Eino Tunkelo (Finland Inst. of Tech., Helsinki). Acta Polytech. Scand., Phys. Nucl. Ser., No. 26, 18p.(1963).

An attempt was made to evaluate the time-dependent pair correlation function of an assembly of atoms from measurements of inelastic neutron scattering at a fixed angle. The method employed is based on the assumption that the classic pair correlation function is Gaussian, of which the time-dependent width is determined by fitting the measured distributions in energy of the scattered neutrons at 90°, after allowing first for the detailed balance factor. The method was applied to the case of scattering by water. The results obtained display behavior which is correct quantitatively for short time intervals and at least qualitatively for longer periods. (auth)

10226 INELASTIC INCOHERENT SCATTERING OF SLOW NEUTRONS BY UNORDERED SOLID SOLUTIONS. I. P. Dzyub. Fiz. Tverd. Tela, 6: 1866-82(1964).

The Green function was used to formulate a regular method of investigating indicated scattering. Single-phonon incoherent scattering of slow neutrons by binary unordered solid solutions were examined. An expression, represented by a series of concentrations of one of the components, was obtained for the differential effective scattering cross section of neutrons. In considering only the difference in masses of component atoms in the solution, a detailed study of low concentrations was made. Peculiarities in the cross section of inelastic neutron scattering by nonideal crystals must be expected when the force constants change during replacement of atoms in the crystal matrix by impurity atoms. Indirect support of this is found in the characteristic temperature dependence of Mössbauer line intensity for impurity nuclei: when quasilocal oscillation occurs at a temperature considerably below the Debye temperature for an ideal lattice, the intensity of the Mössbauer line falls exponentially with temperature, whereas, with local oscillations, the temperature dependence of the Mössbauer line is weak, even at temperatures greater than the Debye temperature of an ideal crystal. Investigation of peculiarities in the oscillation spectrum of nonideal crystals is possible only by means of inelastic scattering of low neutrons. The best material for such a study is V with impurity atoms of Sn because coherent scattering is very weak here and the force constants remain practically unchanged during replacement of V atoms by Sn. (auth)

10227 ON THE POSSIBILITY FOR USING NEUTRON RESONANCE CAPTURE TO STUDY THE VIBRATION SPECTRUM OF IMPURITY ATOMS IN CRYSTALS. S. V. Maleev (Ioffe Inst. of Physics and Tech., Leningrad). Fiz. Tverd. Tela, 6: 2717-22(Sept. 1964).

The addition of a small isotope impurity consisting of neutron resonance capturing nuclei which capture at less than 1 ev converts a weakly neutron-absorbing substance to a strongly neutron-absorbing one in which practically all the absorption is accounted for by impurity nuclei. Since the resonance energy lies in a region which is close to thermal, it appears possible to reestablish the vibration frequency $g(\omega)$ of the impurity nucleus according to the relation between the absorption cross section and the energy. There is a discussion of the accuracy of such a restoration, and it is shown that an accuracy on the order of 10% may be attained in the high frequency region. (auth)

10228 THE S_4 AND FEW-GROUP DIFFUSION CALCULATIONS OF FAST REACTORS. Masao Ohta, Hiroshi Nishihara, and Yoko Deguchi. Mem. Fac. Eng., Kyoto Univ., 25: 273-86(1963).

To economize on a large amount of the numerical work in fast breeders calculations, a study was done in the hope that few-group diffusion theory might give acceptable results in some cases. A hypothetical ^{233}U-^{232}Th system with large core size (~670l) as well as a hypothetical ^{239}Pu-^{238}U fast reactor with small core size (~50l) are adopted. These systems are assumed to be of spherically symmetric geometry. One dimensional calculations are applied to obtain the static characteristics. The results from few-group S_4 and diffusion methods are investigated. These results seem to indicate that four- or three-group diffusion calculations might be used in place of the three-group S_4 computation for both large and small fast reactors. A new convergence criterion imposed upon the static parameters is proposed. The leakage rate of neutrons from the blanket is selected as the sensitive measure of convergence. This rate is estimated in two ways, by using neutron current and by neutron inventory. The sufficiently converged state can be reached when these two values coincide with each other. The necessary number of spatial mesh points can be inferred by comparing these two values. (auth)

10229 THE SLOWING DOWN OF NEUTRONS IN HYDROGENOUS MIXTURES. Harvey Amster (Univ. of California, Berkeley). Nucl. Sci. Eng., 21: 206-16(Feb. 1965).

The spatially-independent spectrum of neutrons slowing down in an infinite medium with constant cross sections is calculated from both the Laplace transform exactitude (LTE) and a generalized synthetic kernel approximation (SKA). The fluxes are expressed as sums of exponentials in lethargy and compared asymptotically. For hydrogenous mixtures, two of an infinite number of terms from the LTE are non-oscillatory, both dominate all others at large lethargies, and one vanishes whenever hydrogen is a sole or missing constituent. The SKA yields a solution consisting of as many exponentials as isotopes present. The longest-lived terms are generally most accurate, but even the dominant one can be exact only if there is no absorption or if hydrogen is the sole moderator. For binary mixtures, both terms in the SKA fluxes are non-oscillatory, and the secondary one vanishes for the same concentrations that make the corresponding term in the LTE vanish. Analytic expressions for errors in the asymptotic flux from the SKAs are given as a function of lethargy, all the cross sections, and masses. For every instance observed, the exact asymptotic flux is bounded on different sides by values from the Greuling-Goertzel and Selengut-Goertzel SKAs. (auth)

10230 ON THE FEASIBILITY OF MEASURING HIGHER TIME DECAY CONSTANTS. Ajoy K. Ghatak and Henry C. Honeck (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 21: 227-39(Feb. 1965). (BNL-8115)

An extensive series of calculations was performed to study the approach to equilibrium of a neutron pulse in water and graphite. All calculations are based on multigroup diffusion theory with space dependence represented by the DB^2 term. The time dependence of the neutron density, following a neutron burst at $t = 0$, is obtained by solving explicitly the time- and energy-dependent diffusion equation. The decay constants are thereafter computed and compared with the true eigenvalues of the scattering operator. Wherever possible, the theoretical calculations are compared with experiments. (auth)

10231 BOUNDARY CONDITIONS FOR THE UNSYMMETRICAL SPHERICAL-HARMONICS METHOD IN CYLINDRICAL GEOMETRY. L. D. Noble and J. O. Mingle (Kansas State Univ., Manhattan). Nucl. Sci. Eng., 21: 240-9(Feb. 1965).

In the spherical-harmonics component form of the Boltzmann equation for a cylindrical system with radial symmetry and z-dependence, application of the commonly applied boundary conditions gives rise to more equations than there are unknowns. Selected combinations of the equations resulting from the application of these radial boundary conditions for the P_3 approximation are considered. Numerical evaluation of the angular flux at a free surface and at an interface between two different media shows that a combination of equations which closely satisfies the desired conditions is that suggested by Davison. (auth)

10232 A MONTE CARLO TECHNIQUE FOR SELECTING NEUTRON SCATTERING ANGLES FROM ANISOTROPIC DISTRIBUTIONS. R. R. Coveyou (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 21: 260-2(Feb. 1965).

When the Monte Carlo method is used to solve neutron transport problems, angular distributions can be included to as high a degree of accuracy as desired. However, in general, the higher the degree of accuracy demanded the more costly the solution since the selection of a scattering angle becomes an elaborate procedure and requires a large amount of computer time. A selection method is presented which gives the same accuracy as that obtained by a straightforward selection from a Legendre expansion but requires considerably less computer time. (C.E.S.)

10233 SOME TESTS OF COVEYOU'S ANISOTROPIC SELECTION TECHNIQUE. W. E. Kinney (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 21: 262-5(Feb. 1965). (ORNL-P-114)

The application of the anisotropic selection technique and its proper inclusion into the Monte Carlo neutron-transport code 05R were tested by several calculations and comparisons. One-velocity problems with isotropic scattering in the laboratory system were chosen for study with the anisotropy being introduced in the center-of-mass system in such a way as to result in isotropic laboratory scattering. (C.E.S.)

10234 THE ALBEDO PROBLEM. G. C. Pomraning (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Sci. Eng., 21: 265-8(Feb. 1965).

The problem of computing the probability that a neutron will be reflected (the albedo) if it is perpendicularly incident on a semi-infinite halfspace is considered. A previous method of solution consisted of introducing an approximation into the integral transport equation describing the problem and led to a simple analytic result for the albedo. It is shown that the application of the variational method to this problem also leads to a simple analytic expression for the albedo and that this result is significantly more accurate. (C.E.S.)

10235 NEUTRON SCATTERING BY POLYETHYLENE. Juan U. Koppel and James A. Young (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nucl. Sci. Eng., 21: 268-70(Feb. 1965). (GA-5600)

The frequency spectrum of polyethylene is discussed, and by means of reasonable assumptions concerning the frequency distribution a scattering kernel suitable to calculate the thermal neutron spectra in polyethylene is derived. (C.E.S.)

10236 VOID STREAMING IN S_N CALCULATIONS. Tom Olsen (Martin Co., Baltimore). Nucl. Sci. Eng., 21: 271-2(Feb. 1965).

Correction for transverse void streaming losses in one- or two-dimensional transport solutions by means of S_N calculations is discussed. (C.E.S.)

10237 COMMENTS ON "GENERALIZATIONS OF FICK'S LAW." A. W. Solbrig, Jr. (Phillips Petroleum Co., Idaho Falls, Idaho). Nucl. Sci. Eng., 21: 272-3(Feb. 1965).

The validity and applicability of a generalization of Fick's law (M. D. Kostin, Nucl. Sci. Eng., 19: 252(1964)) that uses the concept of neutron pressure for homogeneous isotropic media and slab geometries is considered. (C.E.S.)

10238 QUASICLASSICAL THEORY OF NEUTRON SCATTERING. M. Rosenbaum and P. F. Zweifel (Univ. of Michigan, Ann Arbor). Phys. Rev., 137: B271-84(Jan. 25, 1965).

A Wigner representation is used for expressing the thermal average occurring in the Van Hove formalism for slow-neutron scattering from macroscopic systems. For quadratic and lower-degree potentials, results in closed form may be obtained, and in general an asymptotic series expansion in powers of $\hbar$ is still possible for the incoherent part of the differential cross section for quasiclassical systems. The lead term of this asymptotic expansion results in an expression relating the cross section to a four-dimensional Fourier inversion of the classical space-time distribution $G_s^c(r,t)$, and hence to the classical motions of the atoms in the scattering system. Correction terms of $O(\hbar^2)$ are obtained explicitly and found to be small for systems at ordinary temperatures. It is shown that (at least to order $\hbar^2$) the results obey the constraint of detailed balance and satisfy the Placzek moments. It is also shown that, because of the contact nature of the Fermi pseudopotential, the exact classical limit ($\hbar \to 0$) for any system is the ideal-gas result. In principle, the results can be extended to all orders of $\hbar^2$. No similar asymptotic expansion appears to exist, however, for the coherent cross section. The analysis is then used for deriving other existing prescriptions and for examining their implications and range of validity. (auth)

10239 CONTROL OF DEUTERIUM PRESSURE IN A GAS-FILLED NEUTRON TUBE. E. P. Gel (All-Union Research Inst. of Geophysics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 5, 190-1(Sept.-Oct. 1964). (In Russian)

A scheme is given of a device for controlling pressure in a UNG-1 type neutron tube with a Penning-type ion source and an incandescent cathode. The ion current in the cold cathode of the source was used as a compression transducer. The pressure of deuterium in the gas-filled neutron tube was analyzed as a function of the magnitude of the current flow over cooled or heated deuterium. (R.V.J.)

10240 ANALYTIC EXPRESSIONS FOR CALCULATING NEUTRON DISTRIBUTION FUNCTIONS BY MONTE CARLO. Wilson Kinter Talley. Thesis, Berkeley, Calif., Univ. of California, 1964. 100p.

In Monte Carlo calculations, the successive directions and energies of a particular history of a neutron slowing down in a homogeneous medium can be determined without reference to the locations of the collisions. For each set of such discrete directions, the analytic form of the spatial distribution of any particular collision is developed by integrating over that of the previous collisions. Not only is the statistical error of such a method less than that of ordinary Monte Carlo, but an analytic expression for the energy distribution of the last collision enables one to calculate a sample of the vector flux density at chosen positions and energies. Previously, the use of analytic spatial distributions has provided scattering probability densities for plane source neutrons in an infinite homogeneous medium and for a plane source on the boundary of a finite slab. The solution to the more general problem of a plane source anywhere within the finite slab is presented here; however, the main portion of this thesis treats the more complicated three-dimensional problems involving point sources. The scattering probability distribution functions for a point source in an infinite and a semi-infinite medium are developed, and the spatial moments of the former are given. The results for the plane source are shown to follow those from the point source. The extension of this method to finite bodies is discussed. The problem of round-off error (due to machine truncation) is examined, and a method to circumvent it is set forth. (Dissertation Abstr., 25: No. 3, Sept. 1964)

Nuclear Properties and Reactions

Refer also to abstract 9897.

10241 (AERE-M-1464) A SYSTEMATIC APPROACH TO THE EVALUATION OF CHAIN MEMBER YIELDS IN RADIOACTIVE DECAY CHAINS. I. S. McGill (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Nov. 1964. 21p. Dep.; $0.70(BIS); 3s.6d. (HMSO).

A calculation procedure is developed, readily amenable to computer programming, for the calculation of the chain member yields in radioactive decay chains, or in the analogous isotope production chains for isotope production by neutron absorption. The calculation procedure has the advantage that it entails only the systematic repetition of a number of simple arithmetical operations on two triangular arrays of numbers, which are readily derived from the decay constants of the production chain members. After calculation of chain member yields for some time interval T, the effort required in calculating the yields at any integral multiple of T is minimal, as is the effort in repeating the calculation for a series of different initial concentrations. A STRETCH FORTRAN program based on the calculation method is described. (auth)

10242 (JINR-P-1824) POLNOE SECHENIE VZAIMODEISTVIYA NEITRONOV S ENERGIEI 630 Mev S PROTONAMI I YADRAMI UGLERODA. (The Total Cross Section for 630 Mev Neutron Interaction With Protons and Carbon-Nuclei). Yu. M. Kazarinov, V. I. Satarov, and Yu. N. Simonov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 4p. Dep.(mn)

Using the neutron beam attenuation method, the total cross sections of neutron interaction (the effective neutron energy being 630 Mev) with protons and carbon nuclei have been measured. The corresponding total cross sections were found to be $\sigma^{t}_{np} = (35.2 \pm 0.9) \times 10^{-27}$ cm^2 and $\sigma^{t}_{nc} = (324.0 \pm 1.5) \times 10^{-27}$ cm^2. It follows from the data obtained that the imaginary part of the elastic forward N−N scattering amplitude is Im $f(0) = (0.77 \pm 0.02) \times 10^{-13}$ cm. (auth)

10243 (JINR-P-1837) DVOINAYA PEREZARYADKA π^--MEZONOV. (Double Charge of π^- Mesons). Yu. A. Batusov, S. A. Bunyatov, V. M. Sidorov, and V. A. Yarba (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 5p. Dep.(mn).

A double charge exchange of mesons (π^+) at 30 to 80 Mev with 0.5×10^{-27} cm^2 nuclear cross section was used in investigations of double meson (π) charge exchange in various nuclei. It is shown that the probability of double charge exchange of mesons (π^+) increased with an increase of primary meson energy. All recorded events were related to the primary 40 to 87 Mev mesons with a meson (π^-) double charge exchange cross section of $(0.09 \pm 0.03) \times 10^{-27}$ cm^2, which is smaller than the cross section for meson (π^+) double charge exchange cross sections at identical energies. Stars with a small number of prongs are characteristic of nuclear spallations produced in meson(π^-) double charge exchange. Most of such stars (85%) have only secondary π^+ meson tracks. The mean number of charged particles per one star (not counting mesons (π) and electrons) is 0.18. A corresponding number of stars in double charge exchange of mesons (π^+) is 1.65. A picture of typical events of π^+ and π^- double charge exchange in nuclear emulsions is included. (R.V.J.)

10244 (JINR-P-1857) ISSLEDOVANIE SPEKTRA KONVERSIONNYKH ELEKTRONOV I SPEKTROV POZITRONOV NEODIMOVOI FRAKTSII. NOVYI IZOTOP Nd^{137}. (Investigation of the Conversion Electron and Positron Spectra of Neodymium Fraction. New Isotope Nd^{137}). K. Ya. Gromov, B. S. Dzhelepov, Zh. Zhelev, V. G. Kalinnikov, A. V. Kudryavtseva, V. V. Kuznetsov, N. A. Lebedev, G. Muziol, and Z. Kherrmann (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1964. 17p. Dep.(mn).

A new activity of neodymium was observed with 55 min. half life. The genetic relation of the observed activity with its daughter isotopes (^{137}Pr and ^{137}Ce) was investigated. The conversion electron and positron spectra of the discovered isotope ^{137}Nd was measured. The decay scheme of ^{137}Nd was proposed. Data are also presented concerning the conversion electron spectrum of ^{139}Nd. (auth)

10245 (JINR-P-1863) O MEKHANIZME RADIOAKTIVNOGO RASPADA S ISPUSKANIEM PROTONOV. (On a Mechanism of the Radioactive Decay Accompanied by Proton Emission). L. A. Petrov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Reactions). 1964. 5p. Dep.(mn).

The interpretation of experimental data on radioactive decay accompanied by the proton emission has been considered. Some specific features of the mechanism for the emission of delayed protons are discussed in the case of the quantum-mechanical passage through the Coulomb barrier. (auth)

10246 (JINR-P-1881) O MEKHANIZME OBRAZOVANIYA ZHESTKIKH ZARYAZHENNYKH CHASTITS V REAKTSIYAKH MEZHDY SLOZHNYMI YADRAMI. (On a Mechanism of High-Energy Charged Particle Production in Reactions Induced by Complex Nuclei). S. P. Ivanova and B. N. Kalinkin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 3p. Dep.(mn).

A model is proposed of production and angular distribution of high-energy charged particles in reactions between complex nuclei. (auth)

10247 (JINR-P-1882) O SVYAZANNOM SOSTOYANII TREKH CHASTITS. (On Bound Three-Body State). B. N. Zakhar'ev and R. K. Kalinauskas (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1964. 13p. Dep.(mn).

The penetration of any barriers in opposite directions is strictly identical for elementary particles. But for complex particles, the coefficients of penetration through the non-symmetrical barrier in opposite directions may be essentially different at an energy sufficient for real excitation of the higher states of internal motion. We are faced with this effect in considering different nuclear phenomena, e.g. α−decay and α−particle scattering on nuclei. (auth)

10248 (KFKI-23/1963) INVESTIGATION OF COULOMB STRIPPING IN THE B^{10}(d,p,γ) REACTION BY MEASURING THE γ-CIRCULAR POLARIZATION. J. Zimányi, J. Erö, Elona Fodor, and I. Szentpétery (Magyar Tudományos Akadémia Központi Fizikai Kutató Intézete, Budapest). 1963. 12p. Dep.(mn).

An investigation is made of the relative contributions of direct and compound-nucleus reactions to the ^{10}B(d,p,γ) cross sections at deuteron energies on the order of 400 kev. The ^{10}B Coulomb barrier is 2 Mev, so that the deuteron energy is well below the Coulomb barrier. The d−p−γ (4.46 Mev) circular polarization correlations and directional correlations are measured. It is concluded that the direct reaction mechanism is predominant at this deuteron energy. Nuclear and deuteron parameters are also induced from the results, and the validity of the interaction models used is analyzed. (T.F.H.)

10249 (NP-14477) POLARISATION NUCLEAIRE DE NOYAUX D'OR 198 DISSOUS DANS LE GADOLINIUM (these). (Nuclear Polarization of Gold-198 Nuclei Dissolved in Gadolinium (thesis)). Jean Gizon (Grenoble, France. Universite). 1963. 65p. Dep.(mn)

The methods used for the production of oriented nuclei are reviewed and the description of the orientation by the f_k parameters is derived. The angular distribution of the γ radiations emitted by oriented nuclei, the effect of preceding transitions on the γ radiations, and the magnetic field acting on oriented nuclei are calculated. The experimental assembly used for the study of the nuclear polarization and the experimental procedure are described. The results obtained on the nuclear polarization of ^{60}Co in a Co–Ni alloy and of ^{198}Au in Gd are reported. (J.S.R.)

10250 (NP-14496) ETUDE DE TRANSITIONS γ DE FAIBLE ÉNERGIE DANS L'EUROPIUM 153 PAR EFFET PHOTOELECTRIQUE (theses). (Study of γ Transitions of Weak Energy in Europium-153 by the Photoelectric Effect (thesis)). Paul Chédin (Grenoble, France. Universite). 1963. 60p. Dep.(mn)

Two conversion coefficients of ^{153}Eu at 69.7 and 103.2 kev were measured using the photoelectric effect. The external conversion electrons were used in the measurement with an original source-converter geometric apparatus that is described. The experimental techniques and the results obtained were reported. The precision of the method used was discussed. (J.S.R.)

10251 (NP-14498) CONTRIBUTION A L'ETUDE DES ELECTRONS DE CONVERSION INTERNE DE LA DESINTEGRATION: $P_m^{151} \rightarrow S_m^{151}$ (theses). (Contribution to the Study of Internal Conversion Electrons in the Decay $Pm^{151} \rightarrow Sm^{151}$ (thesis)). Georges Marguier (Lyon. Université). June 7, 1963. 76p. Dep.(mn).

The decay scheme of ^{151}Pm was studied using a double-focusing ironless spectrometer of high resolution. The experimental methods used were described, and the results of a bibliographic study of the activity of ^{151}Pm were reported. The experimental results showed the existence of new transitions. A nuclear scheme for ^{151}Sm was proposed that assumes a spherical form for the nucleus. (J.S.R.)

10252 (NP-14583) POISKI INTERFERENTSII MEZHDU POTENTSIAL'NYM I REZONANSNYN ZAKHVATOM NEITRONOV V REZONANSE X ZOLOTA 4,9 EV. (Interference Between the Potential and Resonance Capture of Neutrons in Gold Resonance at 4.9 ev). D. Dorchoman, B. Kardon, and D. Kish (Joint Inst. for Nuclear Research, Dubna, U. S. S. R. Lab. of Neutron Physics). 1963. 10p. Dep.(mn)

The capture cross sections were determined for the ^{197}Au(n,γ)^{198}Au reaction. The γ spectra were investigated in order to reveal the interference between potential and resonance capture in the Au resonance at 4.9 ev. The interference was not observed. Considering that the direct capture process is performed by seven strongest lines then the ratio of the potential capture to the resonance capture cross section at resonance energy is $\kappa \lesssim 8 \times 10^{-8}$. (tr-auth)

10253 (NP-14626) ON THE REAL PART OF THE SCATTERING AMPLITUDE OF PROTON-NUCLEUS INTERACTIONS AT 12 Gev/c AND 24 Gev/c (thesis). Dirk Jacobus Holthuizen (Amsterdam. Universiteit). 1964. 70p. Dep.(mn).

Measurements have been made of the elastic and inelastic interactions of protons of 12 and 24 Bev/c in nuclear emulsion. For this purpose, 500 m tracks of 12 Bev/c and 650 m tracks of 24 Bev/c protons were followed under the microscope. Special recorders were connected to these microscopes in order to show small deflections in the tracks with a large angle magnification. The aim was to investigate the presence of a real part of the scattering amplitude. Three models were used to analyze the experimental results. The potential model describes the nucleus by a square well potential V + iW. The parameters of the best fit for 12 Bev/c protons are $R_0 = 1.40$ fm if the radius of the region of the potential distribution is given by $R = R_0A^{1/3}$ (A is the number of nucleons in the nucleus), W = 22 Mev and V = 13 Mev. For 24 Bev/c protons the best fit parameters are $R_0 = 1.40$ fm, W = 22 Mev and V = 10 Mev. The phase shift model describes the nucleus by a square well phase shift function $\delta_R + i\delta_I$. The parameters of the best fit for 12 Bev/c protons are $R_0 = 1.37$ fm, $\delta_I = 0.375$ and $\delta_R = -0.26$. For 24 Bev/c protons the best fit parameters are $R_0 = 1.37$ fm, $\delta_I = 0.375$ and $\delta_R = -0.22$. The granular model considers the composition of the nucleus in nucleons. The only adjustable parameter is the ratio x between the real and imaginary parts of the scattering amplitude. The best fit value of x is 0.25 for 12 Bev/c and 0.20 for 24 Bev/c protons. In all three models a real part of the scattering amplitude is necessary to obtain a description of the experimental results. The interference between the coulomb scattering amplitude and the real part of the nuclear scattering amplitude is constructive. (auth)

10254 (ORNL-3672) 14-Mev NEUTRON REACTIONS. J. E. Strain and W. J. Ross (Oak Ridge National Lab., Tenn.). Jan. 1965. Contract W-7405-eng-26. 63p. Dep.; $3.00(OTS).

Reactions observed when pure, naturally occurring elements (Z = 1 to Z = 30) are irradiated with unmoderated 14-Mev neutrons produced by the ^{3}T(d,n)^{4}He reaction are listed. Cross sections are calculated where possible, and normalized standard gamma spectra are collected. These standard spectra are equivalent to the gamma radioactivity that will be produced when 1 g of the pure element is irradiated for a given length of time at a 14-Mev neutron flux of 5×10^8 neutrons cm^{-2} sec^{-1}. If more than one radionuclide is produced, a spectral decay is presented. These spectra may be used to predict accurately the sensitivity of nondestructive spectral analysis of almost any sample. (auth)

10255 (ORNL-TM-971) STATISTICAL-MODEL CALCULATIONS OF DIFFERENTIAL CROSS SECTIONS FOR TWO HEAVY-ION INDUCED REACTIONS. H. F. Bowsher (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 27p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The differential cross sections $d^2\sigma/dEd\Omega$ for the reactions ^{16}O(^{14}N,α)^{26}Al and ^{27}Al(^{14}N,α)^{37}Ar were calculated. Four exit channels were included, corresponding to proton, neutron, deuteron, and alpha-particle emission. Best fits of the calculated $d^2\sigma/dEd\Omega$ with the experimental data were obtained by using a level density expression that is a product of $[\exp(2\sqrt{aE})]/E^2$ and a non-gaussian spin cut-off term. (auth)

10256 (RISO-92) EXPERIMENTAL INVESTIGATIONS OF DECAY SCHEMES OF DEFORMED NUCLEI (thesis). P. Gregers Hansen (Denmark. Atomenergikommissionen. Forsøgsinstitut, Risø). Sept. 1964. 82p. Dep.(mn).

Techniques are described for separating radioisotopes, preparing radioactive sources by electrodeposition of insoluble hydroxides, gamma spectrometry, beta spectrometry, and coincidence counting. The use of these techniques for spectroscopic classification of deformed nuclei is investigated. Experimental data are surveyed. (T.F.H.)

10257 (TID-21335(p.33-107)) EXPERIMENTAL PROGRAM. (Minnesota. Univ., Minneapolis. Linear Accelerator Lab.).

Experimental and theoretical studies are reported on proton elastic and inelastic scattering and reactions (p,d), (p,t), and (p,α) in the 10-Mev energy range, on light and medium nuclei. (T.F.H.)

10258 (TID-21335(p.151-60)) THEORETICAL PROGRAM. (Minnesota. Univ., Minneapolis. Linear Accelerator Lab.).

Theoretical studies are reviewed of: a distorted-wave analysis of electron scattering by nuclei (e.g., Au); diagrams for the ^{6}Li(p,2p) reaction; singlet-even potential kernels for nucleon–nucleon interactions; vector-meson analyses of nucleon form factors; and representations of SU_3. (T.F.H.)

10259 (UCRL-7666) OPTICAL MODEL ANALYSIS OF THE SCATTERING OF PROTONS BY MAGNESIUM. H. F. Lutz and J. B. Mason (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 22, 1964. Contract W-7405-eng-48. 15p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The nuclear optical model is applied to the scattering of protons by magnesium. Using a potential well with standard geometry, the model is moderately successful above 10 Mev incident proton energy. No fits are possible below 8.92 Mev incident energy and also in a region about 9.3 Mev. This behavior is discussed in terms of resonances in the compound system. (auth)

10260 (UCRL-7670) THE SCATTERING OF 12.0-Mev DEUTERONS BY THE SEPARATED ISOTOPES OF SILVER. H. F. Lutz, S. F. Eccles, and J. B. Mason (California. Univ., Livermore. Lawrence Radiation Lab.). Jan. 23, 1964. Contract W-7405-eng-48. 17p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The scattering of 12.0-Mev deuterons by separated isotope targets of ^{107}Ag and ^{109}Ag has been studied. It is found that the angular distributions show no diffraction pattern and are almost identical. Several optical potentials generate equally good fits to the data. (auth)

10261 TRANSMISSION CURVE OF THE S^{35} CONTINUOUS BETA-RADIATION IN AIR. T. Vertse and D. Berényi (Inst. of Nuclear Research, Academy of Sciences, Debrecen, Hungary). Acta Phys. Acad. Sci. Hung., 18: 67-72(1964).

The transmission curve in air for continuous β radiation from ^{35}S was measured. The intensity of the radiation decreased to about half its original value after penetrating 15 mm of air at atmospheric pressure. Data are presented in graphs. (M.C.G.)

10262 DECAY DATA ON SOME Xe, I, AND Te ISOTOPES. G. Andersson, G. Rudstam, and G. Soerensen (CERN, Geneva). Arkiv Fysik, 28: 37-43(1964).

In connection with studies on nuclear reaction yields of Xe, I, and Te isotopes some decay data were obtained. These data, including half lives, positron and gamma energies, and $(EC)_K/\beta^+$ branching ratios, are reported. Among the results are measurements on the previously unknown isotopes 6 min ^{118}Xe, 6 min ^{119}Xe, and 40 min ^{120}Xe. (auth)

10263 RADIATIVE CAPTURE OF NEUTRONS BY COPPER AND MOLYBDENUM NUCLEI. V. A. Tolstikov, V. E. Kolesov, A. G. Dovbenko, and Yu. Ya. Stavisskii. At. Energ. (USSR), 17: 505-8(Dec. 1964). (In Russian)

The energy variation of the cross sections of neutron radiative capture at 5 to 200 kev by ^{65}Cu and ^{100}Mo was measured using the relative activation method. Cross sections for neutron radiative capture by ^{63}Cu, ^{65}Cu, and ^{100}Mo were calculated by computer, using the optical model for the Woods-Saxon potential. The compound-nucleus parameters and the values of energy level, spin, and parity used in the calculations are presented. Graphs are presented for cross sections on ^{63}Cu, ^{65}Cu, ^{100}Mo, and natural Cu, containing the results of present and previous experiments and calculations, for neutron energies from 0.001 to about 1 Mev and neutron orbital angular momentum quantum numbers from 0 to 3. (M.J.T.)

10264 PERIOD OF THE FIRST EXCITED STATE OF THE NUCLEUS OF HAFNIUM-172. Hussein Abou-Leila (Université de Paris, Orsay, France). Compt. Rend., 259: 3003-6(Nov. 2, 1964). (In French)

By the use of a time-amplitude converter, the half life of the first excited state of ^{172}Hf was measured as $T_{½} = 1.55 \pm 0.10 \times 10^{-9}$ sec. The half life of ^{172}Ta was found to equal 44 ± 1 min. The γ spectrum of ^{172}Hf is given and the results are discussed. (tr-auth)

10265 NUCLEAR PHOTOACTIVATION OF INDIUM. Yvette Cauchois, Yvonne Héno, and Michel Boivin (Institut Fourier, Grenoble, France). Compt. Rend., 259: 3233-40 (Nov. 9, 1964). (In French)

Photoactivation of indium induced by bremsstrahlung radiation produced in an accelerator, which yields an electron beam with energy variable between 0.2 and 2 Mev, was studied. The study confirmed that the activation can be made in this region by at least three levels of excitation (1.07, 1.49, 1.56 Mev). The experiments showed that the activation can be produced beginning at 0.935 Mev. Measurements were made of the integrated cross sections and partial radiative lengths. This permitted a discussion of the probable character of the low-energy activation level. (tr-auth)

10266 MEASUREMENT OF ANGLE DISTRIBUTION OF POLARIZATION OF PROTONS IN $C^{12}(p,p)C^{12}$ REACTION IN THE 6.0–6.8 Mev ENERGY RANGE. P. Bém, J. Habanec, O. Karban, J. Nemec, and V. Presperin (Nuclear Research Inst., Czechoslovak Academy of Sciences, Řež). Czech. J. Phys., 14: 798-800(1964). (In Russian)

Results are presented of the polarization of protons elastically scattered on ^{12}C, for proton energies from 6.0 to 6.8 Mev and scattering angles from 25 to 150°. The degree of polarization of the scattered protons was determined according to right-left asymmetry of the second scattering on the analyzer C target. (M.J.T.)

10267 THE FORMATION RATE OF RADIOACTIVE ISOTOPES IN CHONDRITES BY COSMIC RAYS. A. K. Lavrukhina, R. I. Kuznetsova, and L. M. Satarova (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Moscow). Geokhimiya, No. 12, 1219-27(Dec. 1964). (In Russian)

Cross sections for radioactive product formation in interactions of protons at 120 to 660 Mev with nuclei of aluminum were studied. This element's mass number and atomic number correspond to weighted average values for chondrites. It was found that the formation cross section of isotopes with $\Delta A = A_0 - A_{prod}$ (where A_0 is the mass number of the element target and A_{prod} is the mass number of the product) less than ten, does not change in the region of proton energies from 120 Mev to 28 Bev. If ΔA is greater than ten, the formation cross section of isotopes with an energy growth from 120 Mev to 1 Bev strongly increases. Values of formation cross sections of cosmogenic isotopes were computed according to semiempirical formulas. They agreed with experimental values at a proton energy of 660 Mev. An estimation of maximum formation rates of cosmogenic radioactive was made for the center of chondrites with a radius of 10 cm with regard for their average chemical composition. (auth)

10268 ON THE UNIFIED THEORY OF NUCLEAR REACTIONS. V. S. Gur'yanov (Saratov State Univ., USSR). Izv. Vysshikh. Uchebn. Zavedenii, Fiz., No. 5, 106-10(1964). (In Russian)

A variation of the formal nuclear reaction theory was studied considering the identity of all nucleons in the system. A precise analytical expression was derived for scattering amplitudes in the case of a finite number of nuclear target levels. A system of Fredholm equations was developed for a general case of the interaction hamiltonian matrix elements. (tr-auth)

10269 ISOTOPE EFFECTS ON ^{59}Co MAGNETIC SHIELDING IN $K_3Co(CN)_6$. Paul C. Lauterbur (State Univ. of New York, Stony Brook). J. Chem. Phys., 42: 799-800 (Jan. 15, 1965).

Measurements of the ^{13}C and ^{15}N isotope shifts in $K_3Co(CN)_6$ were made and may be partially explained in terms of the theory developed for the temperature dependence of the shielding. The contribution to the shift of the mass effect on the effective separation of the ground and excited states could be approximated for $Co(^{13}CN)_6^{3}$ by the expression $\sigma_> - \sigma_< = B_0 (P/4\Delta^2) [1 - (m_</m_>)^{½}] \omega_{eff} (1 - a^2)$ in which B_0 is an empirical constant (450 cm^{-1}), P, the number of normal modes, is 15, Δ is the crystal-field splitting parameter [32200 cm^{-1} in $K_3CO(CN)_6$], $m_</m_> = 26/27$, ω_{eff} is the appropriately weighted average over all of the vibrational frequencies of the complex (taken as 500 cm^{-1}), and a is the ratio of the effective vibrational frequency in the excited electronic state to that in the ground state (0.7). The calculated shift of 7.8 ppm agreed well, considering the assumptions involved, with the experimental one of 5.46 ppm. (M.C.G.)

10270 PHOTOPROTONS FROM FLUORINE AND CARBON. Seiji Seki, Mikio Yamanouchi, and Mitsuo Miwa (Tokyo Univ. of Education). J. Phys. Soc. Japan, 19: 1999-2003(Nov. 1964).

The (γ,p) reactions in fluorine and carbon were studied with bremsstrahlung of energies up to 24 Mev. Photoprotons were observed by using nuclear plates. Energy spectrum of photoprotons from fluorine exhibits peaks at 3.8, 4.6, and 7.4 Mev which are in good accord with those observed previously by Forkman and Wahlström, and Dodge and Barber. In addition to these peaks at 1.9 and 2.8

and a somewhat uncertain peak at 6.1 Mev were found. Angular distributions of photoprotons from fluorine showed an asymmetry around 90° with respect to the direction of incident photons, which suggests interference between absorbed photons of different parities. In the case of carbon, a main peak at proton energy of 6.0 Mev was observed along with slight humps at 4.5 and 5.2 Mev. The observed structure is in good agreement with those reported previously. (auth)

10271 ELASTIC AND INELASTIC COLLISIONS OF 55 Mev PROTON WITH ^{4}He. Satio Hayakawa, Naoaki Horikawa, Ryoichi Kajikawa, Ken Kikuchi, Hisashi Kobayakawa, Kazuhisa Matsuda, Shinobu Nagata, and Yoshio Sumi (Nagoya Univ., Japan). J. Phys. Soc. Japan, 19: 2004-13(Nov. 1964).

Elastic and inelastic collisions induced by 55-Mev protons with ^{4}He nuclei were investigated by use of the $\Delta E - E$ counter detecting protons and deuterons, and the solid counter detecting recoil ^{4}He and ^{3}He nuclei. The differential cross sections at 15–160° were measured for the elastic scattering and for the inelastic process ^{4}He(p,d)^{3}He. The total cross section for the latter is 40 mb. The total cross section for all inelastic events were estimated from the continuum portion in the energy spectra of protons as 50–80 mb. The existence of an excited state in ^{4}He at the excitation of about 22 Mev was indicated by searching an anomalous peak in the energy spectra of protons. (auth)

10272 DECAY OF Ce^{135}. Kaoru Takahashi, Manabu Fujioka, and Kazuo Hisatake (Tokyo Inst. of Tech.). J. Phys. Soc. Japan, 19: 1014-22(Nov. 1964).

The decay of ^{135}Ce was studied by measuring internal conversion and singles and coincidence gamma spectra. Twenty-one transitions are assigned to the decay of ^{135}Ce. They are 205(18), 265(100), 300(55), 515.5(27), 569 and 570.5, 602(56), 661(≈9), 777(21), 821(21), 865(≈13), 901(≈8) and weak transitions of 52.4, 87.4, 117, 118, 132, 379, 544, 549, and 679, where energies are indicated in kev and relative transition intensities are written in parentheses. Coincidence pairs of 265–515, 265–602, 265–901, 300–569 or 570.5, 300–865, and 205–570 or 602 kev were found from gamma-gamma coincidences. Multipolarities of some transitions are assigned from K/L ratios and conversion coefficients. A tentative decay scheme is proposed. (auth)

10273 COUPLING OF EQUIVALENT PARTICLES IN A FIELD OF GIVEN SYMMETRY. Masao Kotani (Uppsala Univ.). J. Phys. Soc. Japan, 19: 2150-6(Nov. 1964).

A system of N identical particles is considered, which are subject to a common external field V(x,y,z) and interact with each other as given by a spin-free symmetric operator V_1. V is assumed to be invariant against rotations of a group $\mathcal{G}$. When these particles are assigned to orbitals of a degenerate bound level γ of $\mathcal{G}$, a single configuration γ^N is obtained. Interaction V_1 splits this configuration into a number of states, each of which is characterized by an irreducible representation Γ of $\mathcal{G}$ and an irreducible representation Σ of the symmetric permutation group. A general formula is derived by which the number $n(\Gamma,\Sigma)$ of states with representations Γ and Σ arising from a configuration γ^N is easily obtained. The application of this method is discussed for the following cases: Russell-Saunders' coupling of electrons in an atom, coupling of electrons assigned to a degenerate molecular orbital, or electrons in an ion subject to a strong ligand field, and coupling of nucleons in a nucleus for the case in which the interaction is assumed independent of ordinary spin as well as of isotopic spin. The method is shown to be applicable also to the case of j–j coupling. (auth)

10274 DEUTERONS FROM CARBON IRRADIATED BY HIGH ENERGY BREMSSTRAHLUNG. Motohiro Kihara, Kota Baba, Kozo Miyake, Terue Nakamura, Tetsuji Yamaki, Shinjiro Yasumi, and Yoshio Yoshimura (Kyoto Univ.). J. Phys. Soc. Japan, 19: 2236(Nov. 1964).

The (γ,d) reaction on carbon was investigated in the energy range 400 to 720 Mev to study the nucleon-nucleon correlation in the nucleus. Preliminary results of the differential cross sections are reported. (C.E.S.)

10275 ODD PARITY STATES IN ^{28}Si STUDIED BY STATISTICAL TENSOR ANALYSIS OF (p, γ, γ) ANGULAR CORRELATIONS. R. Nordhagen and A. Tveter (Universitetet, Oslo). Nucl. Phys., 63: 529-47(Mar. 1965).

In the decay of the 1118 kev resonance of the ^{27}Al(p, γ)^{28}Si reaction, a state at 8.41 Mev is excited which almost exclusively decays to the 6.88 Mev ($J\pi = 2^-$) state. Also a state at 9.70 Mev decaying to the 8.41 Mev state is seen. To analyze the angular correlations observed, a statistical tensor representation is used to avoid the limitation of the method based on correlations of γ-transition multipolarities. The necessary methods for a statistical tensor analysis are given. The analysis gives the spin and parity of the 8.41 Mev states as $J\pi = 3^-$, and the multipolarity of the transition to the 6.88 Mev state as almost pure quadrupole. The resonance level at an excitation energy of 12.67 Mev has $J\pi = 4^-$. The decay of the odd parity resonance level to states of odd parity is attributed to the effect of the isobaric spin selection rule on dipole transitions. (auth)

10276 LONGITUDINAL DEPOLARIZATION OF NEGATONS. L. Braicovich, B. De Michelis, and A. Fasana (Instituto di Fisica del Politecnico, Milan). Nucl. Phys., 63: 548-50(Mar. 1965).

The average longitudinal polarization of β particles of ^{90}Y, transmitted through depolarizer foils 100 mg/cm^2 thick, was measured with a Moeller analyzer, in the energy range 0.4 to 1.8 Mev. The depolarization increases with the atomic number and attains a value of about 20% when a gold foil is inserted in the beam. The measured values agree with the results of calculations based on a theory given by Passatore. (auth)

10277 THE Cr^{52}(d, pγ) Cr^{53} REACTION. A. A. Rollefson, R. C. Bearse, J. C. Legg, G. C. Phillips, and G. Roy (Rice Univ., Houston, Tex.). Nucl. Phys., 63: 561-74(Mar. 1965). (TID-20991)

Energy levels and gamma decay schemes for the nucleus ^{53}Cr were observed in the reaction ^{52}Cr(d, pγ)^{53}Cr using particle-gamma coincidence techniques. Levels were observed at 0.56, 1.01, 1.29, 1.54, 1.97, 2.32, 2.69, 3.19, 3.60, and 3.70 Mev. Tentative spin and parity assignments were made for a number of these levels by combining the gamma decay results with the results of other experiments, particularly stripping analysis. (auth)

10278 SEARCH FOR STRUCTURE IN THE ELASTIC SCATTERING OF O^{16} BY O^{16} UTILIZING A GAS TARGET. E. B. Carter, P. H. Stelson, M. K. Mehta, and D. L. Bernard (Rice Univ., Houston, Tex.). Nucl. Phys., 63: 575-80 (Mar. 1965). (TID-20874)

Excitation curves for the elastic scattering ^{16}O by ^{16}O were taken with approximately 40 kev resolution in the bombarding energy range from 19 to 27 Mev. No significant resonant structure was observed, confirming earlier work with a resolution of 250 kev. Techniques are described for the study of heavy ion reactions in a differentially pumped gas scattering chamber. (auth)

10279 SYMMETRY RELATIONSHIPS FOR THE ROTATIONAL COLLECTIVE MODEL. S. A. Williams (Ames Lab., Ames, Iowa). Nucl. Phys., 63: 581-7(Mar. 1965). (IS-912)

Davydov's sum rule for hydrodynamic-rotor energy levels of angular momenta 2 and 3 is shown to be a special case of a more general sum rule valid for any quantal rotor. This sum rule and other useful energy relations are shown to follow from symmetry considerations. Deviations from the simple energy relations, arising when the rotation-vibration model of even nuclei is considered, are also discussed. (auth)

10280 THE ^{18}O(α, p) REACTION AND THE BETA DECAY OF ^{21}F. J. L. C. Ford, Jr., J. K. Bair, C. M. Jones, and H. B. Willard (Oak Ridge National Lab., Tenn.). Nucl. Phys., 63: 588-92(Mar. 1965). (ORNL-P-258)

The ^{18}O(α, p)^{21}F reaction was studied at 7.76 to 9.95 Mev by observing, with approximately 2π geometry, the beta particles following the ^{21}F decay. Prominent peaks in the yield curve occur at incident particle laboratory energies of about 7.86, 8.36, 8.61, 8.71, 8.83, 8.94, 9.16, 9.28, 9.43, and 9.82 Mev. The observed width of the peaks exceeds the experimental resolution of about 20 kev. A half life of 4.35 ± 0.04 sec was determined for the ^{21}F beta decay. (auth)

10281 A RELATIVE MEASUREMENT OF THE $Li^6(n,\alpha)H^3$ REACTION CROSS SECTION IN THE RANGE $1 < E_n < 600$ kev. S. Schwarz, L. G. Stroemberg, and A. Bergstroem (Research Inst. of National Defence, Stockholm). Nucl. Phys., 63: 593-609(Mar. 1965).

The $^6L(n, \alpha)^3H$ reaction cross section was measured with a time-of-flight technique, using a ^{6}Li glass scintillator as a detector of neutrons produced by the $^7Li(p, n)^7Be$ reaction. In the low-energy range the results are based on the assumption that the neutrons from the latter reaction are isotropically distributed in the center-of-mass system for proton energies close to the neutron threshold. In the higher energy range the measurement is based on the (n, p) scattering cross section. A fit according to the Breit-Wigner single-level dispersion theory was made for the p-wave resonance at $E_n \approx 0.25$ Mev, taking into account the $1/\nu$ dependence of the cross section at low energies, extrapolated from the thermal value. (auth)

10282 DELAYED ANGULAR CORRELATION IN LIQUID SOURCES. D. E. Brandão, E. R. Fraga, Alice Maciel, and F. C. Zawislak (Universidade do Rio Grande do Sul, Porto Alegre, Brazil). Nucl. Phys., 63: 610-14(Mar. 1965).

Delayed gamma-gamma angular correlations were measured for the 173–247 kev cascade in ^{111}Cd from sources of ^{111}In dissolved in hydrochloric acid, glycerine, and acetic acid. The measured attenuation of the coefficients of the angular correlation function is discussed in terms of the interaction mechanism which produces these attenuations. (auth)

10283 TWO-PARTICLE EMISSION IN NUCLEAR REACTIONS. Helmut Buettner, Albrecht Lindner, and Heiner Meldner (Universität, Frankfurt am Main). Nucl. Phys., 63: 615-24(Mar. 1965).

The cross sections for the emission of two particles are calculated with the statistical theory of nuclear reactions using reasonable values for the cross sections for the formation of a compound nucleus and for the level density. The emission of γ rays is taken into account as a process competing with the evaporation of particles. It is found that the agreement between the calculated and observed cross sections is satisfactory in the examples studied (^{50}Cr, ^{52}Cr, ^{54}Fe, ^{56}Fe, ^{58}Ni, ^{60}Ni bombarded with neutrons up to 16 Mev). The competition of γ emission is only important near the threshold of the considered reaction, where the level density formula fails to give a reliable result. Some systematics of the dependence of the cross sections on nucleon numbers are discussed. (auth)

10284 FISSION OF U^{238} WITH NEUTRONS FROM 2 TO 5 Mev. V. Emma, S. Lo Nigro, C. Milone, and R. Ricamo (Università, Catania, Italy). Nucl. Phys., 63: 641-9(Mar. 1965).

The fission cross section of ^{238}U and the angular distribution of fragments of fission induced by neutrons were measured with nuclear plates, ZnS (Ag) detectors, and solid state detectors. Monoenergetic (±100 kev) neutron beams with 2 Mev $< E_n <$ 5 Mev obtained by the D(d, n) reaction, were used. The cross section shows a more evident minimum around $E_n = 3.3$ Mev than earlier reported. The fragment anisotropy in the angular distribution varies between 1.47 ± 0.03 at $E_n = 1.71$ Mev and 1.17 ± 0.03 at $E_n = 5.19$ Mev. (auth)

10285 ELASTIC AND INELASTIC SCATTERING OF PROTONS BY Li^7. R. Gleyvod, N. P. Heydenburg, and I. M. Naqib (Florida State Univ., Tallahassee). Nucl. Phys., 63: 650-6(Mar. 1965).

The differential cross section for the elastic and inelastic scattering of protons by ^{7}Li was measured. A resonance observed in the elastic cross section at an incident proton energy of 4.2 Mev is interpreted as an almost pure single-particle level in ^{8}Be at an excitation energy of 20.9 ± 0.2 Mev, with a width of 1.57 ± 0.18 Mev and a total angular momentum and parity $J^\pi = 4^-$. It is suggested that this level is of the configuration $[(1s_{1/2})^4(1p_{3/2})^3] + 1d_{5/2}$ in jj-coupling notation. (auth)

10286 THE PROTON YIELD DUE TO THE DISINTEGRATION OF 26 AND 23 Mev DEUTERONS IN THE COULOMB FIELD OF NUCLEI. F. Udo, H. R. E. Tjin A Djie, and L. A. Ch. Koerts (Instituut voor Kernphysisch Onderzoek, Amsterdam). Nucl. Phys., 63: 657-72(Mar. 1965).

Proton production from bombardment of Au and Cu nuclei with 26 and 23 Mev deuterons was measured. A comparison of proton angular distributions with the results of a simple calculation based on the electric disintegration of the incident deuterons is given. This analysis supports the hypothesis that electric break-up of the deuteron outside the nucleus is mainly responsible for the observed proton continua. (auth)

10287 THE (n, p), (n, α), AND (n, 2n) CROSS SECTIONS FOR F^{19} AND Na^{23} BETWEEN 13 AND 21 Mev. J. Picard and C. F. Williamson (CEN, Saclay). Nucl. Phys., 63: 673-84(Mar. 1965).

The (n, p), (n, α), and (n, 2n) cross sections for ^{19}F and ^{23}Na were measured by the activation method. In all cases the products were identified by their half periods and/or characteristic gamma rays. Comparison is made between the measured cross sections and those calculated on the basis of the statistical theory. The comparison between theory and experiment shows satisfactory agreement for the (n, α) and (n, p) reactions, but certain discrepancies in the case of the (n, 2n) reactions. (auth)

10288 MAGNETIC MOMENT OF THE 160 kev STATE IN Cs^{133}. Y. K. Agarwal, C. V. K. Baba, and S. K. Bhattacherjee (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys., 63: 685-8(Mar. 1965).

The magnetic moment of the 160 kev state in ^{133}Cs was measured to be $\mu = 3.3 \pm 0.8$ nm by perturbing the observed angular correlation pattern of the 276–160 kev gamma-gamma cascade in an external magnetic field. Directional correlation results on this cascade confirm the spin of the 160 kev state to be $^5/_2$. (auth)

10289 EFFECT OF NUCLEAR SURFACE DIFFUSENESS ON DIFFRACTION SCATTERING. E. V. Inopin and Yu. A. Berezhnoy (Inst. of Physics and Tech., Kharkov). Nucl. Phys., 63, 689-94(Mar. 1965).

A simple method is proposed for taking into account nuclear surface diffuseness in diffractional scattering. Theoretical predictions are compared with experimental data on the scattering of α particles by ^{24}Mg. The range of α particles in nuclear matter is estimated. (auth)

10290 THE MAGNETIC MOMENT OF THE $^9/_2{}^+$ ROTATIONAL STATE IN Lu^{175}. E. Karlsson, E. Matthias, A. G. Svensson, and K. Johansson (Inst. of Physics, Uppsala). Nucl. Phys., 64: 8-16(Apr. 1965).

The g factor of the $^9/_2{}^+$ state at 114 kev in ^{175}Lu was determined by the perturbed angular correlation method. The result obtained with a ytterbium metal source is $g = +0.40 \pm 0.04$. The ratio between the magnetic interaction strengths with the field applied to the metal source and to an aqueous solution of $Yb(NO_3)_3$ was found to be 1.07 ± 0.13. Since the parent atom is paramagnetic in the solution but not in the metal, different effects due to the atomic recovery might be expected in the two sources. The conclusion is that the recovery time in the liquid sources is <1 nsec. The magnetic parameters of the unified model deduced from this measurement are compared with other determinations in order to check the consistency of the model prediction. (auth)

10291 TIME-DEPENDENT SELF-CONSISTENT FIELD AND COLLECTIVE NUCLEAR HAMILTONIAN. S. T. Belyaev (Inst. of Nuclear Physics, Novosibirsk, USSR). Nucl. Phys., 64: 17-54(Apr. 1965).

An expression for the collective hamiltonian H_c is obtained proceeding from general microscopic concepts; no induced excitation devices characteristic of the cranking model are used. The main approximation is the condition of adiabaticity of collective excitations. The method leads to corrections to the cranking model results. The calculation of the parameters of H_c is illustrated for the pairing + quadrupole interaction model. A method of considering a more realistic interaction is formulated. (auth)

10292 STUDY OF THE REACTION $C^{12}(d,\alpha)B^{10}$ FOR DEUTERON ENERGIES OF 9.2 Mev TO 13.8 Mev. F. Baldeweg, V. Bredel, H. Guratzsch, R. Klabes, B. Kuehn, and G. Stiller (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Nucl. Phys., 64: 55-64(Apr. 1965). (In German)

Angular distributions of the $^{12}C(d,\alpha)^{10}B$ reaction, leading to the ground state and three excited states of ^{10}B, and the energy dependence of the total cross section of the $^{12}C(d,n)^{13}N$ reaction were measured at 9.2 to 13.8 Mev. The angular distributions obtained at 11 energies show typical features of direct processes in the small-angle region and a remarkable change with deuteron energy. Integrated cross sections have a maximum at 11.5 Mev corresponding to an anomaly of the total $^{12}C(d,n)^{13}N$ cross section at the same energy. The angular distributions obtained are not well fitted by means of present direct interaction theories. Intermediate states of ^{14}N are suggested to be important for the mechanism of the $^{12}C(d,\alpha)^{10}B$ reaction in the energy range investigated. (auth)

10293 NUCLEAR STRUCTURE STUDIES IN THE Pt REGION WITH (d,p), (d,t) AND (d,d′) REACTIONS. Paresh Mukherjee (Univ. of Pittsburgh). Nucl. Phys., 64: 65-88 (Apr. 1965).

A survey was made of the particle, hole, and collective states in seven Pt isotopes (A = 193−199) by (d,p), (d,t), and (d,d′) reactions on ^{194}Pt, ^{195}Pt, ^{196}Pt, and ^{198}Pt. The incident deuteron energy is 15 Mev. The $p_{1/2}$, $p_{3/2}$, $f_{5/2}$, $f_{7/2}$ and $i_{13/2}$ quasiparticle states are located in all odd-mass isotopes from an analysis (d,p) and (d,t) cross sections and (d,p) angular distributions. Several p and f states are found distributed up to an excitation of 1.6 Mev. The $g_{9/2}$ state is located around 1.8 Mev in ^{195}Pt, ^{197}Pt, and ^{199}Pt. Above this level several strongly excited states are observed in (d,p) reactions, which are presumably the neutron states in the N = 126−184 shell. In ^{195}Pt the 0.210 Mev state (and possibly the 0.240 Mev state also) is found to be strongly excited in (d,p), (d,t), and (d,d′) reactions, indicating particle and phonon admixtures. The excitation spectra of the three even-mass isotopes are very similar to one another. From (d,p) and (d,t) cross sections the pairing theory parameters V_{2j} for ^{194}Pt and ^{196}Pt are determined for the $p_{1/2}$ state only. (auth)

10294 THE DENSITY DISTRIBUTION OF THE p NUCLEONS IN T = 0 AND T−1 STATES OF Li^6. Daphne F. Jackson and J. Mahalanabis (Battersea Coll. of Tech., London). Nucl. Phys., 64: 97-112(Apr. 1965).

The radial distribution of the p nucleons in the second excited state of ^6Li (T = 1) was investigated through calculations on high energy proton and electron scattering. The results obtained are compared with previous work on the two lower T = 0 states. (auth)

10295 THE n-p PHOTODISINTEGRATION OF HEAVY NUCLEI. Arne Reitan (Norges Tekniske Hogskole, Trondheim, Norway). Nucl. Phys., 64: 113-29(Apr. 1965).

The total cross section for direct absorption of γ rays by neutron-proton pairs is evaluated for nuclear matter in the effective-mass approximation, and for photon energies up to about 200 Mev. Some consideration is given to the influence on the cross section of the finite size of actual nuclei. Electric dipole and quadrupole as well as magnetic dipole transitions are taken into account. (auth)

10296 A NEUTRON SCATTERING STUDY OF Fe^{56}. W. B. Gilboy and J. H. Towle (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Phys., 64: 130-46(Apr. 1965).

Differential cross sections for elastic and inelastic scattering of neutrons by iron were measured at 1 to 4 Mev with a time-of-flight spectrometer. The elastic scattering data were compared with the predictions of several types of optical potential. In the inelastic data direct interaction effects appeared to be negligible, and comparisons with compound nucleus theory enabled limits to be placed on the spins of several levels in ^{56}Fe. (auth)

10297 GAMMA DE-EXCITATION OF FISSION FRAGMENTS. II. DELAYED RADIATION. Sven A. E. Johansson (Univ. of California, Berkeley). Nucl. Phys., 64: 147-60 (Apr. 1965). (UCRL-11740)

The delayed gamma radiation emitted from fission fragments of ^{252}Cf was studied. The fission fragments were detected with semiconductor counters and the gamma radiation with a scintillation spectrometer. Mass-ratio selection was employed so that the properties of the gamma radiation could be studied as a function of fragment mass. The delayed radiation was found to have an intensity of 6% relative to the prompt one. The half life depends on the mass and on the delay. It varies in the range 15 to 100 nsec. The mass spectrum of the fragments associated with delayed gamma radiation was found to exhibit a pronounced fine structure with most of the delayed gamma emission concentrated to deformed and magic fragments. The gamma spectra have a shape consistent with a rotational cascade in deformed nuclei and a vibrational cascade in magic nuclei, respectively. The gamma emission from some of the fragments in the mass range 92 to 110 has the same characteristics as the emission from the deformed fragments in the rare-earth region. It is therefore concluded that these fragments have a stable deformation. Various theoretical and experimental evidence for the existence of this new region of deformation is discussed. (auth)

10298 THE ALPHA DECAY OF Gd^{151} AND Gd^{149}. A. Siivola (Univ. of California, Berkeley) and G. Graeffe. Nucl. Phys., 64: 161-8(Apr. 1965). (UCRL-11559)

A new rare-earth alpha emitter ^{151}Gd was found in measurements carried out with an ionization chamber. Its α-particle energy is 2.60 ± 0.03 Mev, and the rate of alpha decay is approximately 0.8×10^{-8} α particles per K x ray. The alpha decay of ^{149}Gd was studied; 3.01 ± 0.02 Mev was obtained for the α-particle energy and $(4.6 \pm 1.5) \times 10^{-6}$ for the alpha branching, both in agreement with earlier data. Reduced widths for all gadolinium alpha emitters were calculated. (auth)

10299 ON THE DECAY OF Be^9 NUCLEI IN THE 2.43 Mev LEVEL. Juergen Moesner, Guenter Schmidt, and Josef Schintlmeister (Zentralinstitut für Kernforschung, Dresden, Ger.). Nucl. Phys., 64: 169-76(Apr. 1965). (In German)

A CO_2-filled expansion cloud chamber, operated at 240 torr, was used to study the $^{12}C(n,n')3\alpha$ reaction. Of 1267 events accepted for analysis, 128 proceeded via the 2.43-Mev level in $^{9*}Be$. The energy spectra (in the ^9Be cms) of particles emitted in the $^{9*}Be$ decay are shown. The decay modes are considered. (auth)

10300 CAPTURE-TO-FISSION RATIOS OF U^{233}, U^{235}, U^{238} AND Pu^{239} IN EBR-I, MARK III. Carl E. Crouthamel (Argonne National Lab., Ill.), Donald C. Stupegia, Peter Kafalas, and Charles M. Stevens. Nucl. Sci. Eng., 21: 179-85(Feb. 1965).

In order to compare the breeding capabilities of the major nuclear fuels in the spectrum of a fast-breeder reactor, integral measurements were made for the ratio of their capture and fission cross sections in the third loading of the First Experimental Breeder Reactor (EBR-I, Mark III). The capture-to-fission ratio was determined as a function of position in the reactor for ^{233}U, ^{235}U, and ^{239}Pu. In addition, for ^{233}U the ratio of (n,2n) and fission cross sections was determined. Further, for ^{238}U the following cross-section ratios were determined: $\sigma_{n\gamma}(^{238}U)/\sigma_f(X)$ and $\sigma_f(^{238}U)/\sigma_f(X)$, where $\sigma_f(X)$ refers to the fission cross sections of ^{233}U, ^{235}U, and ^{239}Pu. The capture-to-fission ratio results for the three primary fissile species were compared with calculations based upon 16-group neutron diffusion theory using two different sets of monoenergetic neutron cross sections, and the agreement is good. The present data show that of the three major fissile species, ^{239}Pu has the highest value of $\eta-1$, the maximum number of neutrons available for breeding, for each fissile nucleus consumed. (auth)

10301 EFFECTIVE SURFACE OF A TUBULAR ABSORBER IN THE CALCULATION OF RESONANCE INTEGRALS. H. Aisu (Westinghouse Electric Corp., Pittsburgh). Nucl. Sci. Eng., 21: 250-5(Feb. 1965).

The analytical expression for the effective resonance integral of a tubular absorber filled with moderator is obtained for the non-Doppler-broadened situation using the first collision probabilities for tubular geometry and is compared with the simpler expression by Carlvik and Pershagen. The effect of neutron transparency of the fuel on the resonance integral is shown to be important for a thin fuel region, and the correction factor in the calculation of the effective surface is given for the non-Doppler-broadened situation. The effect of Doppler broadening is examined in a simple manner. A correction factor lower than 0.8 is plausible for uranium oxide and metal tubes in the practical problems. (auth)

10302 THE THERMAL CAPTURE CROSS SECTION AND RESONANCE INTEGRAL OF URANIUM-232. J. Halperin, C. R. Baldock, and J. H. Oliver (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 21: 257-8(Feb. 1965). (ORNL-P-183)

Submicrogram samples of ^{232}U containing about 0.75% ^{233}U were irradiated for times up to about a week in a thermal flux of $\approx 10^{14}$ n cm^{-2} sec^{-1}. The ^{232}U cross sections were determined from the measured increase in the ^{233}U content of the samples. The thermal capture cross section and the resonance integral of ^{232}U were determined to be 78 ± 4 and 280 ± 15 barns, respectively. (C.E.S.)

10303 CROSS-SECTIONS FOR THE PRODUCTION OF K^0-MESONS AND HYPERONS AT THE ENERGY OF THE ORDER OF SEVERAL HUNDRED Gev. S. A. Slavatinskii and I. N. Fetisov (Lebedev Inst. of Physics, Moscow). Nukleonika, 9: 245-8(1964). (In Russian)

The energy dependence of strange particle production cross sections was measured using two Wilson cloud chambers combined with an ionization calorimeter. The recorded 262 events of cosmic nucleon interactions with light (Li, He, and Be) and medium (Al and brass) target nuclei at 100 to 500 Bev revealed that the cross section for meson (K^0) production increased by a factor of two in energy increases from 25 to 300 Bev. The data obtained indicated that the maximum cross section for hyperon production reached ⅓ of the inelastic interaction cross section, contradicting Peter's hypothesis (Nuevo Cimento, 23: 88, (1962)), which considered the probability of hyperon emission from high-energy nucleon interactions close to a unit value. The data put the probability of hyperon emission from the slow or fast nucleon at less than 0.2. The increased yield of strange particles from interactions with Al and brass nuclei as compared to the interactions with Li, He, and Be nuclei is considered to be the result of secondary interactions taking place in the nuclei. (R.V.J.)

10304 PRODUCTION OF KNOCK-ON ELECTRONS BY COSMIC-RAY MUONS UNDERGROUND (148 m w.e.). N. Chaudhuri and M. S. Sinha (Regional Engineering Coll., Durgapur, India). Nuovo Cimento (10), 35: 13-22(Jan. 1, 1965).

Knock-on electrons produced by cosmic muons of mean energy 32 Bev in argon and in iron-plates were studied. A total of 294 δ-rays produced in argon were observed in scanning 605 m of muon track length, and their energy spectrum was found to agree quite well with the Rutherford formula in the range 30 to 150 kev. The energy spectra of 379 knock-on electrons produced in 0.54 cm (0.3 rad. unit) thick iron plate and of 2624 electrons produced in 1.6 cm (0.9 rad. unit) plotted in two histograms show good agreement with Bhabha's theory up to momentum transfers of the order of Bev/c. (auth)

10305 NUCLEAR EXCHANGE REACTION. L. F. Abou-Hadid (Alexandria Univ., Egypt). Nuovo Cimento (10), 35: 54-65(Jan. 1, 1965).

The total cross section of the reaction ^{11}B(^{3}He, ^{3}H)^{11}C is analyzed and discussed. The contribution of the direct exchange process as well as that of the compound nucleus is calculated. An interpretation of the maximum observed in the total cross section is discussed. (auth)

10306 ANGULAR CORRELATIONS IN NUCLEAR DIRECT ELECTRODISINTEGRATION. E. Napolitano and G. Ponzano (Università, Turin). Nuovo Cimento (10), 35: 279-83(Jan. 1, 1965).

The single-particle shell model of the nucleus is used to calculate the angular correlations between the inelastically scattered electrons, and the nucleons emitted via the direct electromagnetic interaction induced by the impinging electrons. General results were established and summarized. (auth)

10307 A GENERALIZATION OF THE LEVY AND KELLER METHOD FOR FINDING THE PHASE SHIFTS. T. Tietz (Univ. of Lodz, Poland). Nuovo Cimento (10), 35: 308-10(Jan. 1, 1965).

A generalization of the Levy and Keller equation for finding phase shifts is presented. The generalized equation is a first-order nonlinear equation that can be rewritten in integral form for practical calculations and approximate methods. The radial wave function for a particle in the presence of the spherically symmetric potential $(\hbar^2/2\mu)$ $[V(r)-(a/r)]$ is used in the derivation. This potential plays an important role in the scattering theory of electrons and protons by a modified Coulomb field. (C.E.S.)

10308 EFFECT OF TEMPERATURE ON THE CHANNELING OF Xe^{133} IONS IN GOLD. D. A. Channing and J. L. Whitton (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Letters, 13: 27-8(Nov. 1, 1964).

The effect of target temperature on the channeling of ^{133}Xe ions in gold was investigated at room temperature and at 20°K. A gold single crystal was bombarded in the $\langle 100 \rangle$ direction with singly charged 40-kev ^{133}Xe ions. The penetration distributions were determined by removing thin uniform layers of metal from the target and by measuring the radioactivity of the residual ^{133}Xe in each layer. (C.E.S.)

10309 TEMPERATURE DEPENDENCE OF MÖSSBAUER EFFECT IN IRON. J. Baijal (Univ. of Delhi). Phys. Letters, 13: 32-3(Nov. 1, 1964).

The probability of recoilless gamma transitions in the Mössbauer effect is governed by the Debye-Waller factor, which is normally calculated by using the Debye model for the lattice vibrations. But recent experiments showed the inadequacy of this model. The exponent of the Debye-Waller factor is calculated by using the Born-Von Karman model for lattice vibrations. It is shown in the particular case of ^{57}Fe in a polycrystalline sample of stainless steel that the results indicate a nonlinear relation between the exponent of the Debye-Waller factor and the temperature. This differs from the Debye model results which show a linear dependence at higher temperatures. (C.E.S.)

10310 BAND MIXING OF THE ROTATIONAL AND THE BETA AND GAMMA VIBRATIONAL LEVELS IN Gd^{154}. J. H. Hamilton, T. T. Katoh, W. H. Brantley, and E. F. Zganjar (Vanderbilt Univ., Nashville). Phys. Letters, 13: 43-6(Nov. 1, 1964).

The mixing of the beta and gamma vibrational states with the ground state rotational band in deformed even-even nuclei was discussed. The decay of ^{154}Eu to ^{154}Gd was investigated. Several unreported transitions were found, and the 0^+, 2^+, and 4^+ members of a beta vibrational band were firmly established. A decay scheme for ^{154}Eu is presented. (C.E.S.)

10311 EFFECTIVE CHARGES FOR E2 TRANSITIONS IN THE 1 f $^7\!/_2$ AND g $^9\!/_2$ PROTON ORBITS. J. Vervier (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). Phys. Letters, 13: 47-50(Nov. 1, 1964).

Effective E2 transition operators, obtained by replacing in the real E2 operators the nucleon charge by an effective charge e', larger than e for protons and different from 0 for neutrons, are applied to nuclei with $22 \leq Z \leq 26$, N = 28, i.e., protons in the 1 f $^7\!/_2$ orbit and closed neutron shells, and to those with $40 \leq Z \leq 42$, N = 50, i.e., protons in the 2 p $^1\!/_2$ and 1 g $^9\!/_2$ orbits and closed neutron shells. Experimental and calculated values of the reduced E2 transition probabilities are compared. (C.E.S.)

10312 INVESTIGATION OF THE ^{11}B(^{3}He,^{6}Li)^{8}Be REACTION. F. C. Young, P. D. Forsyth, M. L. Roush, W. F. Hornyak, and J. B. Marion (Univ. of Maryland, College Park). Phys. Letters, 13: 50-3(Nov. 1, 1964).

The ^{11}B(^{3}He,^{6}Li)^{8}Be reaction (Q = 4.56 Mev) was studied at bombarding energies of 1.4 to 3.0 Mev. Angular distributions were measured at 3.0 Mev. The question of the cluster configurations of states in ^{6}Li and ^{11}B was discussed. (C.E.S.)

10313 MEASUREMENT OF MOTT ASYMMETRY AT 100 kev, OF LONGITUDINAL ELECTRON POLARIZATION OF Co^{60} AND Pm^{147} FROM 40 TO 210 kev AND OF A LARGE SOURCE DEPOLARIZATION UNEXPECTED BY THEORY. V. Eckardt, A. Ladage, and U. V. Moellendorff (Universität, Hamburg). Phys. Letters, 13: 53-5(Nov. 1, 1964).

The Mott asymmetry function $S(\theta,Z,E)$ can be measured by the double scattering of β particles with known polarization. For electron energies in the range of 100 kev there are discrepancies between theoretical calculations and experimental results. The polarization of electrons from ^{60}Co and ^{147}Pm sources were measured with an energy resolution of ±2.5 kev in the range from 40 to 210 kev. A double focusing permanent bending magnet transmits only electrons with energies of 100 ± 2.5 kev. The method has the advantage that the scattering at the gold target occurs for all accepted β energies at the same energy of 100 kev. (C.E.S.)

10314 J DEPENDENCE OF THE ANGULAR DISTRIBUTIONS FROM (d,p) REACTIONS TO 1f SINGLE PARTICLE STATES. J. L. Alty, L. L. Green, G. D. Jones, and J. F. Sharpey-Schafer (Univ. of Liverpool). Phys. Letters, 13: 55-9(Nov. 1, 1964).

Differences in the angular distributions for (d,p) stripping to 1f $^{7}/_{2}$ and 1f $^{5}/_{2}$ single particle final states were observed in (d,p) reactions on ^{46}Ti, ^{48}Ti, and ^{50}Cr at a bombarding energy of 9.15 Mev. Spin assignments were made to states of ^{47}Ti, ^{49}Ti, and ^{51}Cr on the basis of the shapes of (d,p) angular distributions. (C.E.S.)

10315 NEW NUCLIDE Ca^{50} AND ITS DECAY SCHEME. Y. Shido (Tokyo Univ.), M. Ishihara, K. Miyano, H. Morinaga, and Ren Chiba. Phys. Letters, 13: 59-61(Nov. 1, 1964).

The nuclide ^{50}Ca was produced by triton bombardments of a ^{48}Ca target at 3.2 Mev. The gamma spectra and a proposed decay scheme of ^{50}Ca are presented. (C.E.S.)

10316 AN ISOBARIC ANALOGUE STATE IN Al^{27} AND THE ROLE OF CONFIGURATIONAL EXCITATION. B. Lawergren (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Phys. Letters, 13: 61-3(Nov. 1, 1964).

The (d,n) reaction on a target nucleus of isobaric spin T may proceed to states of the final nucleus with the two isobaric spins $T \pm \frac{1}{2}$, the spin $T - \frac{1}{2}$ forming the lowest lying levels. In ^{27}Al the isobaric analog of the ^{27}Mg ground state, $T - \frac{3}{2}$, $J^{\pi} = \frac{1}{2}^{+}$, is expected in the 6–8 Mev region from Coulomb energies. Since the ^{26}Mg(d,n)^{27}Al reaction has Q = 6.04 Mev for the ground state transition it is possible to reach the analog state with relatively low bombarding energies. A target enriched to 99% in ^{26}Mg and a deuteron bombarding energy of 2.90 Mev were used. (C.E.S.)

10317 POLARIZATION OF PROTONS ELASTICALLY SCATTERED BY CALCIUM AT 14-18.5 Mev. D. J. Baugh, J. C. Dore, G. W. Greenlees, J. Lowe, and S. Roman (Univ. of Birmingham, Eng.). Phys. Letters, 13: 63-5(Nov. 1, 1964).

An experimental study of the variation with energy of the polarization of protons elastically scattered by calcium is reported. The angular region of the subsidiary oscillation around 100° and an energy range between 14 and 18.5 Mev were investigated. It is concluded that the energy variation of the polarization can be represented on the basis of an optical model by the inclusion of a variable imaginary spin-orbit potential. (C.E.S.)

10318 ISOMERIC STATES IN Ce^{140}, Pr^{140}, Nd^{142}, AND Os^{187}. H. Krehbiel (Universität, Heidelberg). Phys. Letters, 13: 65-6(Nov. 1, 1964).

Measurements are summarized for the isomers observed in the irradiation of natural Ce and Nd with 22-Mev bremsstrahlung. Decay properties and isotopic states are given of a previously unreported isomer that is observed in the irradiation of Pr with 22-Mev bremsstrahlung. An intermediate state populated in the decay of the metastable state ^{187m}Os is reported. (C.E.S.)

10319 s-, p-, AND d-WAVE NEUTRON STRENGTH FUNCTIONS. K. K. Seth (Northwestern Univ., Evanston, Ill.), R. H. Tabony, E. G. Bilpuch, and H. W. Newson. Phys. Letters, 13: 70-2(Nov. 1, 1964).

Measurements of the neutron total cross section are reported for a series of elements in the energy region of 3 to 650 kev with energy resolution of 5 to 10 kev. Several different sample thicknesses were used for the transmission measurements. The data were analyzed for s-, p-, and d-wave strength functions and the phase shifts $\delta'(0)$ and $\delta'(1)$. (C.E.S.)

10320 PRODUCTION OF A 22 Mev POLARIZED DEUTERON BEAM. J. A. R. Griffith and S. Roman (Univ. of Birmingham, Eng.). Phys. Letters, 14: 42-3(Jan. 1, 1965).

The elastic scattering of ^{4}He and ^{3}He particles by deuterium was investigated in a search for a convenient source of spin polarized deuterons. Appreciable asymmetries were found in the elastic scattering by carbon of the 22-Mev deuterons produced by bombarding gaseous deuterium with 30-Mev ^{3}He particles. (C.E.S.)

10321 ON THE PRODUCTION OF PROTACTINIUM-232 BY BOMBARDMENT OF THORIUM-232 BY ACCELERATED Li^{6} AND Li^{7} IONS. A. Fleury and G. N. Simonoff (Universite, Bordeaux). Phys. Letters, 14: 44-5 (Jan. 1, 1965). (In French)

The phenomenon of the dissociation of the light-ion projectile in ion bombardment reactions was studied by radiochemical methods. Quantities of ^{232}Pa and ^{232}U formed in 10.4-Mev ^{6}Li and ^{7}Li bombardment of ^{232}Th targets of various thicknesses were measured. Processes considered were: with ^{6}Li, ^{232}Th $(\alpha,4n)$ and (d,2n); with ^{7}Li, ^{232}Th $(\alpha,4n)$, (t,3n), (d,2n), and (p,n); and $^{232}Pa \rightarrow {}^{232}U$. Absolute cross sections were determined. A discussion is given of the variation of ^{232}Pa formation as a function of Li-ion energy; the variation was obtained from previous calculations of the increase of Li-ion energy in passing through different Th thicknesses. (M.J.T.)

10322 NEW ISOTOPE K^{46} PRODUCED WITH THE $Ca^{48}(d,\alpha)K^{46}$ REACTION. A. Marinov and J. R. Erskine (Argonne National Lab., Ill.). Phys. Letters, 14: 46-8 (Jan. 1, 1965).

The $^{48}Ca(d,\alpha)^{46}K$ reaction initiated by a 12-Mev beam of deuterons from the tandem Van de Graaff was observed with the broad-range magnetic spectrograph. Absolute differential cross sections were measured at 10 and 30°. The ground-state Q value in the reaction was measured to be 1.915 ± 0.015 Mev. Excited states were found at 586, 692, 890, and 1949 kev. An energy level diagram of ^{46}K is constructed, and it is shown that the ^{46}K level diagram has some similarities to the energy levels of ^{38}Cl. (C.E.S.)

10323 LEVELS OF Sm^{152} EXCITED IN THE $Sm^{150}(t,p)$ REACTION. S. Hinds (Atomic Weapons Research Establishment, Aldermaston, Eng.), J. H. Bjerregaard, O. Hansen, and O. Nathan. Phys. Letters, 14: 48-51(Jan. 1, 1965).

A target of samarium enriched to 96.4% in ^{150}Sm was exposed to a 12-Mev triton beam. Protons resulting from (t,p) reactions in the target were momentum analyzed at 24 scattering angles. Excitation energies and relative peak cross sections for proton groups assigned to mass 152 were given. The ground-state transition Q value was measured as 5381 ± 25 kev. It was concluded that three 0^{+} states in ^{152}Sm were excited with appreciable strength in the ^{150}Sm(t,p) reaction. All three states may be considered as parents for the ^{150}Sm ground state. The highest lying of these three states possibly is of approximately spherical shape. (C.E.S.)

10324 A STUDY OF FLUCTUATING LOW-ENERGY (p,n) REACTION CROSS SECTIONS. H. J. Kim (Oak Ridge National Lab., Tenn.). Phys. Letters, 14: 51-3(Jan. 1, 1965). (ORNL-P-674)

Fluctuations in the ^{53}Cr(p,n)^{53}Mn reaction cross section were investigated as part of a systematic survey of fluctuations in low-energy (p,n) reactions. It was found that the low-energy (p,n) cross section of ^{53}Cr fluctuates rapidly with energy. The fluctuation can be described in terms of fluctuations in the level widths and in the level spacings. The integrated cross sections are not correlated amongst themselves at all, and the integrated cross sections have a χ^2 distribution. (C.E.S.)

10325 ALPHA PARTICLES FROM THE PROTON BOMBARDMENT OF ALUMINUM. S. L. Andersen, A. Haug, T. Holtebekk, O. Lonsjo, and R. Nordhagen (Universitet, Oslo, Blindern, Norway). Phys. Norvegica, 1: 7-19(1961-2).

Measurements were made of the absolute yield of α particles to the ^{24}Mg ground state in the proton energy region from 730 kev up to 1390 kev. Angular distributions were also measured for the stronger α-resonances, and in a few cases the resonance parameters, such as spin, parity, and partial widths, were determined. The following resonances in the reaction ^{27}Al(p,γ)^{28}Si were observed also to yield α-particles: 731, 884, 922, 936, 1002, 1182, 1212, 1261, 1274, 1315, and 1387 kev. At 1363.2 ± 0.4 kev a new α-emitting resonance was found, yielding γ rays of very low intensity. The following values for the resonant level spins and parities were established: at 936 kev 2^+ or 3^-, at 1182 kev 2^+, at 1315 kev 4^+, at 1363 kev 2^+, and at 1387 kev 2^+ or 3^-. Absolute yields were found. The dimensionless reduced widths for the resonant level at 1182 kev were $\theta_\alpha^2 = 0.055$ and $\theta_p^2 = 0.003$ (s-wave). For some other levels, limits for partial widths and dimensionless reduced widths are given. (BBB)

10326 LEVEL STRUCTURE IN Au^{197} FROM THE DECAY OF Hg^{197m}, Hg^{197}, AND Pt^{197}. R. G. Helmer and L. D. McIsaac (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev., 137: B223-31(Jan. 25, 1965).

Gamma spectra of ^{197}Hg, ^{197m}Hg, and ^{197}Pt were measured with a NaI(Tl) scintillation spectrometer. Electron spectra were obtained with a silicon detector and permanent-magnet spectrographs. Gamma-gamma coincidence measurements were also made. The K internal-conversion coefficient of the 191-kev transition was found to be 0.77 ± 0.2 and 0.93 ± 0.2 by two different techniques. This result is consistent with an M1 transition and does not necessitate any E0 contribution. The energy of the 279-kev transition from ^{197m}Hg was found to be (279.5 ± 0.6) kev. The experiments indicate the existence of a 269-kev transition depopulating the 269-kev level in the decay of both ^{197}Pt and ^{197}Hg. (auth)

10327 DECAY OF Os^{194}. R. G. Helmer (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev., 137: B232-5 (Jan. 25, 1965).

A sample of ^{194}Os was produced by double neutron capture. The gamma spectrum was measured with a NaI(Tl) scintillation spectrometer and the electron spectrum with a silicon solid-state detector. Gamma-ray photopeaks were observed at 43 and 11 kev. The latter is assumed to be L x-ray peak resulting from L-shell internal conversion of the 43-kev transition. The relative L x-ray intensity then implies this transition has M1 or E1 + 1.5% M2 character. The intensity of this transition relative to those in the ^{194}Ir daughter indicates an intensity of almost 100% of the decays. (auth)

10328 M-SHELL ELECTRON CONTRIBUTION TO ORBITAL ELECTRON CAPTURE. W. M. Hubbard (Georgia Inst. of Tech., Atlanta). Phys. Rev., 137: B245-9 (Jan. 25, 1965).

The probability per unit time for capture of an electron from the M shell is calculated by means of the method used by Brysk and Rose for capture from the L and K shells. In addition, the calculations for L and K shells are extended to give the results for third forbidden and third forbidden unique transitions. These calculations indicate that, at least in the case of unique forbidden transitions, the M/L ratio exceeds 20% for all values of transition energy. The possibility of determining nuclear mass differences, order of forbiddenness of a transition, and numerical values for ratios of the nuclear matrix elements from experimental values of M/L is discussed. This last procedure is applied to the determination of the nuclear matrix elements of ^{185}Os. (auth)

10329 ISOMERS WITH HALF-LIVES IN THE RANGE 5–1000 MICROSECONDS OBSERVED IN PULSED 15-Mev DEUTERON BEAM BOMBARDMENT OF NATURAL ELEMENTS. A. L. McCarthy, B. L. Cohen, and L. H. Goldman (Univ. of Pittsburgh). Phys. Rev., 137: B250-65 (Jan. 25, 1965).

Eighteen new isomers were observed in a pulsed 15-Mev deuteron beam survey of 72 elements. Gamma transitions were observed using time and energy channels in a two-dimensional 4096-channel analyzer. Isomers of Ca, Sc, Ti, Zr, Ag, Sn, Ba, La, Pr, Eu, Tb, Er, Tm, Yb, Hf, W, and Re were found. Eleven isomers previously reported were confirmed, and in some cases further information on them was obtained. (auth)

10330 MUON SCATTERING EXPERIMENT ON NUCLEAR STRUCTURE OF C^{12}. Richard O. Stenerson and Robert W. Williams (Univ. of Washington, Seattle). Phys. Rev., 137: B266-71(Jan. 25, 1965).

The differential cross section for the scattering of 1.09 Bev/c muons in carbon, summed over all final energies, was measured in the laboratory angular range 10 to 20° using a spark-chamber detector. The experimental results agree in a general way with the theoretical predictions for reasonable wave functions, but both theory and experiment lack the precision necessary for a critical test of the best available wave functions. The future utility of muon beams, as compared to electrons, is briefly discussed. (auth)

10331 POLARIZATION OF PROTONS ELASTICALLY SCATTERED BY OXYGEN. R. A. Blue and W. Haeberli (Univ. of Wisconsin, Madison). Phys. Rev., 137: B284-93 (Jan. 25, 1965). (COO-7-333)

Measurements of the polarization of protons elastically scattered by oxygen were made at 2 to 12 Mev by double scattering using gas targets. Scattering by helium at 46° was used as the polarization analyzer for most of the work. In addition, four angular distributions of the cross section were measured between 2.5 and 3.8 Mev. The experimental results show that away from the known sharp resonances at 2.66 and 3.47 Mev the polarization changes slowly with energy between 2 and 5 Mev. At 3 Mev the polarization is negative at forward angles and positive at back angles, the observed extrema being −0.14 ± 0.02 at 45° and 0.43 ± 0.03 at 115°. At higher energies the pronounced resonance structure causes rapid fluctuations of the polarization with energy. Angular distributions of the polarization were measured at eleven energies away from sharp resonances. At 10.7 Mev the observed extrema in the polarization are −0.88 ± 0.04 at 50°, 0.92 ± 0.04 at 65°, and −0.83 ± 0.03 at 133°. A phase shift analysis of the polarization and cross section was made between 2 and 5 Mev and at four energies between 5 and 7 Mev. The phase shifts obtained differ from those of Salisbury and Richards by less than 10°. The measured angular distributions of the polarization between 8 and 12 Mev are also compared with the predictions of the optical model. New results of the polarization for p-α scattering and p-C scattering between 2 and 4 Mev are also reported. (auth)

10332 TOTAL PHOTONEUTRON CROSS SECTIONS OF CARBON AND MAGNESIUM. K. Min and W. D. Whitehead (Univ. of Virginia, Charlottesville). Phys. Rev., 137: B301-4(Jan. 25, 1965). (TID-20922)

The total photoneutron cross sections of natural carbon and magnesium were measured from thresholds to 30 Mev. The neutron yield curves, determined in 0.5-Mev intervals using a bremsstrahlung beam, were analyzed by the Penfold-Leiss method to obtain two independent sets of cross sections of 1-Mev interval. The carbon cross section exhibits major structure at 18.8, 22.0, and 25.5 Mev, the integrated cross section up to 28 Mev being 39.2 Mev-mb. The magnesium cross section indicates levels at 17.0, 19.5, 21.5, 23.5, and 25.5 Mev with an integrated cross section up to 28 Mev of 90.7 Mev-mb. The magnesium cross section also shows a small structure at 14.7 Mev due to ^{25}Mg and ^{26}Mg. The experimental results are compared with the available particle-hole-model calculations of E1 levels. (auth)

10333 SCATTERING OF 22-Mev ALPHA PARTICLES BY Fe^{56}, Zn^{64}, Zn^{66}, AND Zn^{68}. H. L. Wilson and M. B.

Sampson (Indiana Univ., Bloomington). Phys. Rev., 137: B305-14(Jan. 25, 1965).

Angular distributions for alpha elastic and inelastic scattering to the lowest 2^+ and 3^- states in ^{56}Fe, ^{64}Zn, ^{66}Zn, and ^{68}Zn were measured. The elastic distributions extend from 20 to 167° and the 2^+ distributions from 30 to 167°. The 3^- distribution extends from 30 to 107° for ^{56}Fe, whereas for the Zn isotopes the range is from 60 to 167°. The optical model was used to fit the elastic-scattering distributions, and the parameters thus found were used in fitting the 2^+ distributions using a distorted wave Born approximation calculation. Three sets of optical-model parameters were found that would fit the elastic scattering distributions (for $\theta \leq 125°$). The real parts of the optical-model potential for these three sets are $V_0 = -20$, -40, and -70 Mev. It was found that only the set with $V_0 = -20$ Mev also gave good fits to the 2^+ distributions. For $\Theta > 125°$, the fits were found to be quite poor. Two suggestions were made to explain the failure of the theory at such large scattering angles. Nuclear deformabilities obtained by fitting the inelastic 2^+ data are in good agreement with those obtained by inelastic proton scattering and electromagnetic methods. Approximations and limitations associated with the theoretical interpretation are discussed. (auth)

10334 ELASTIC SCATTERING OF ALPHA PARTICLES BY HELIUM BETWEEN 53 AND 120 Mev. P. Darriulat (Univ. of California, Berkeley), G. Igo, H. G. Pugh, and H. D. Holmgren. Phys. Rev., 137: B315-25(Jan. 25, 1965). (UCRL-11603)

The differential cross section for α elastic scattering by ^{4}He was measured between 10 and 90° cms at laboratory bombarding energies of 53.40 ± 0.15 Mev, 58.49 ± 0.16 Mev, 63.91 ± 0.18 Mev, 69.91 ± 0.20 Mev, 77.55 ± 0.22 Mev, 99.60 ± 0.28 Mev, and 119.86 ± 0.34 Mev. These differential cross sections were analyzed in terms of complex phase shifts $\mathrm{Re}\,\delta_l + i\mathrm{Im}\delta_l$. The real parts of the phase shifts vary smoothly as a function of energy; the $l = 0$, 2, and 4 phase shifts continue the trends apparent at lower energies; a broad $l = 6$ resonance is found at a center-of-mass energy of about 26 Mev; and evidence is found for an $l = 8$ resonance. The imaginary parts of the phase shifts are appreciable at all the energies of measurement. The real parts of the phase shifts obtained from these and previous measurements were fitted with an l-dependent potential constructed from a Saxon-Woods repulsive core and a complex Saxon-Woods attractive well of larger radius. The potential is found to be in qualitative agreement with theoretical predictions. Approximate fits were made to the real parts of the phase shifts using the single-level dispersion theory. The energies and reduced widths of the resonances given by these fits are approximately proportional to $J(J + 1)$. (auth)

10335 SUBTHRESHOLD NEUTRON-INDUCED FISSION CROSS SECTION OF Am^{241}. C. D. Bowman, M. S. Coops, G. F. Auchampaugh, and S. C. Fultz (Univ. of California, Livermore). Phys. Rev., 137: B326-31(Jan. 25, 1965). (UCRL-7971)

The corona-type spark chamber was adapted for detection of fission fragments and used as the detector for neutron-induced fission cross-section measurements of ^{241}Am. Measurements were made over the neutron energy range from 0.032 to 80 ev. The ratio of average fission width to spacing is in good agreement with that predicted from the shape of the fast-neutron fission threshold. The number of effective fission channels obtained from an analysis of the distribution of fission widths was found to be 2.9 ± 0.6. (auth)

10336 PARTICLE EMISSION IN HEAVY-ION REACTIONS. Donald V. Reames (Univ. of California, Berkeley). Phys. Rev., 137: B332-45(Jan. 25, 1965). (UCRL-11349 (Rev.))

Light charged particles produced at 0° in the interaction of 167-Mev ^{16}O ions with Al, Ni, Ag, and Au thick targets were analyzed magnetically with nuclear-emulsion detectors. The spectra obtained are compared with extensive statistical-model calculations, which include both the effects of angular momentum and of multiple particle emission. The spectra from light targets are seen to be sensitive to the equilibrium shape of the compound nucleus, since rotational effects that depend on this shape are large for these nuclei. For ^{16}O on Au the de-excitation of the compound nucleus is found to be dominated by neutron emission, and a comparison of the calculations with neutron spectra seems to show that the nucleus fissions with highest probability after about 5 ± 1 stages of neutron emission. Owing to the increased competition of neutron emission, charged-particle evaporation for the heavier elements decreases so much that the observed spectra are dominated by direct reaction products. These products, particularly the Li isotopes, are seen to arise from a breakup of the incident ^{16}O, and the energetics of this process are considered. (auth)

10337 FURTHER EVIDENCE FOR THE NONEXISTENCE OF PARTICLE-STABLE TETRANEUTRONS. S. Cierjacks, G. Markus, W. Michaelis, and W. Poenitz (Kernforschungszentrum, Karlsruhe, Ger.). Phys. Rev., 137: B345-6(Jan. 25, 1965).

A search was made for the occurrence of particle-stable tetraneutrons in the fast-deuteron induced fission of uranium. This process is known to give a high yield of alphas and tritons. In order to deduce the presence of tetraneutrons, the following hypothetical reactions were investigated: $^{14}N(n^4,n)^{17}N$, $^{16}O(n^4,t)^{17}N$, $^{26}Mg(n^4,2n)^{28}Mg$, $^{103}Rh(n^4,2n)^{105}Rh$, $^{209}Bi(n^4,n)^{212}Bi$, and $^{209}Bi(n^4,2n)^{211}Bi$. No evidence for tetraneutrons was found. The upper limits of tetraneutron yields per alpha obtained from the above reactions are 2×10^{-8}, 3×10^{-4}, 3×10^{-5}, 3×10^{-4}, 1×10^{-8}, respectively. It seems reasonable to conclude from these results that the existence of tetraneutrons is most unlikely. (auth)

10338 POLARIZATION OF NEUTRONS FROM THE $C^{13}(p,n_0)N^{13}$ AND $N^{15}(p,n_0)O^{15}$ REACTIONS. B. D. Walker, C. Wong, J. D. Anderson, J. W. McClure, and R. W. Bauer (Univ. of California, Livermore). Phys. Rev., 137: B347-51(Jan. 25, 1965). (UCRL-7676(Rev.I))

The polarization of neutrons from the $^{13}C(p,n_0)^{13}N$ and $^{15}N(p,n_0)^{15}O$ reactions was measured for proton energies between 6.9 and 12.3 Mev and neutron-emission angles between 0 and 90°. The neutrons were detected using the Livermore time-of-flight facility incorporating pulse-shape discrimination to reduce the time-independent background. The left and right measurements were obtained by employing a solenoid for spin precession. Liquid helium was utilized as an analyzer. Large polarizations (50 to 70%) were measured for both reactions at several energies and angles. Corrections for multiple scattering in the analyzer were made. The measurements are compared with the polarization predictions of the quasielastic model of the (p,n) process. (auth)

10339 RADIATIVE μ^- CAPTURE IN COPPER. William T. Chu, Irving Nadelhaft, and Julius Ashkin (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 137: B352-66(Jan. 25, 1965).

The radiative capture of negative muons in copper ($\mu^- + \mathrm{Cu} \rightarrow \mathrm{Ni} + \nu + \gamma$) was measured. The muons were captured in the copper plates of one spark chamber and the gamma rays converted in the lead plates of a second spark chamber. A large (8 in. × 8 in.) NaI crystal was used to measure the gamma energy. The apparatus was sensitive to gamma rays of energy larger than 50 Mev. The observed gamma spectrum is compared to a theoretical spectrum based on a Fermi-gas model of the nucleus. The comparison gives branching ratios for radiative muon capture relative to ordinary muon capture of $R = (4.6 \pm 0.7) \times 10^{-4}$ for $M^* = M_p$ and $R = (5.2 \pm 0.8) \times 10^{-4}$ for $M^* = M_p/2$, where M^* is the effective nucleon mass used in the model and M_p is the mass of the proton. An attempt is made to extrapolate the observations in copper to the case of a free proton. (auth)

10340 ANGULAR MOMENTUM AND NUCLEAR SHELL EFFECTS IN REACTIONS OF Ni^{58} WITH 46- TO 68-Mev He^4 IONS. Marshall Blann and George Merkel (Univ. of Rochester, N. Y.). Phys. Rev., 137: B367-77(Jan. 25, 1965).

Excitation-function measurements are reported for reactions induced in ^{58}Ni with 46–68-Mev helium ions. Targets were enriched to 99.95% ^{58}Ni. The stacked-foil method followed by radiochemical separation was used to measure product yields resulting from the (α,αn), (α,αp), (α,α2n), (α,αpn), (α,α2pn), (α,αp2n), and (α,3pn) reactions. The experimental excitation functions (supplemented with previously reported cross sections for reactions of ^{58}Ni with 14–48-Mev helium ions) were compared with three sets of statistical-theory calculations. The calculations differ in the dependence on energy and angular momentum assumed for the nuclear level density. In the first set of calculations the distribution of levels in the residual nuclei was assumed to be of the conventional form, $\rho(E,J) \propto (2J+1)(E-\delta)^{-2} \exp\{2[a(E-\delta)]^{1/2}\}$, where E is the excitation energy, J is the spin of the residual nucleus, δ is the pairing energy correction, and a is the level-density parameter. In the second set of calculations, the influence of nuclear shell structure on level densities was taken into consideration by the introduction of an energy shift ΔE as suggested by Rosenzweig. The residual nuclei are assumed to have a distribution of nuclear levels of the form $\rho(E,J) \propto (2J+1)(E-\delta+\Delta E)^{-2} \times \exp\{2[a(E-\delta+\Delta E)]^{1/2}\}$. In the third set of calculations (applied to the (α,αp), (α,αpn), and (α,αp2n) excitation functions) the influence on the level densities of large values of angular momentum was considered in a relatively simple manner. The residual nuclei were assumed to undergo classical rotation with energy of rotation, $E_{rot} = I^2\hbar^2/2\mathcal{J}_{rig}$, where I is the angular momentum introduced by the bombarding helium ion and $\mathcal{J}_{rig}$ is the nuclear rigid-body moment of inertia. The rotational energy was assumed to be dissipated by γ emission (with J = I throughout the evaporation process). Essentially, the residual nuclei were assumed to have a distribution of levels given by an expression of the form $\rho(E,J) \propto (2J+1)(E-\delta E-_{rot}) \times \exp\{2[a(E-\delta-E_{rot})]^{1/2}\}$. The pairing energy δ was calculated from experimental mass values; the level-density parameter used was $\alpha = 7.0$ Mev^{-1}, the value measured by Sherr and Brady from ^{58}Ni(p,α) spectra. Nonelastic cross sections calculated with the nuclear optical model were used for inverse cross sections. The relation of the third set of calculations to the compound-nucleus theory of Ericson and Strutinski is discussed. An estimate of the error resulting from the use of the simple rotational energy model rather than the more rigorous theory of Ericson and Strutinski is presented. (auth)

10341 EFFECT OF β VIBRATIONS ON MULTIPLE COULOMB EXCITATION WITHIN THE GROUND-STATE BAND. H. G. Wahsweiler (Yale Univ., New Haven). Phys. Rev., 137: B377-80(Jan. 25, 1965). (YALE-1807-15)

Alder and Winther's theory of multiple Coulomb excitation is applied to the rotation-vibration model of axially deformed nuclei. It is shown that in the transition region of deformed nuclei the differences between experimental values and theoretical excitation probabilities of the rotational model can be explained. (auth)

10342 TRIPLE CORRELATIONS IN THE ^{60}Ni(p,$\gamma\gamma$)^{64}Cu REACTION. C. R. Gossett and L. S. August (Naval Research Lab., Washington, D. C.). Phys. Rev., 137: B381-97 (Jan. 25, 1965).

Triple-directional-correlation measurements were performed for the ^{60}Ni(p,$\gamma\gamma$)^{61}Cu reaction in order to determine the excitation energy (in Mev), the spin and probable parity, and the E2/M1 amplitude ratio (for the transition from the intermediate state to the ground state) for the low-lying states as follows: 0.47, ($^1/_2{}^-$), indeterminate; 0.95, $^5/_2{}^-$, 0.35 ± 0.03; 1.37, $^5/_2{}^-$, $3.78^{+0.15}_{-0.13}$; 1.63, ($^3/_2{}^-$), −0.29 to −1.68, or ($^5/_2{}^-$), −0.61 to −3.01; 1.89, $^3/_2{}^-$, −0.08 to −0.42 or −1.19 to −2.48; and 2.07, ($^1/_2{}^-$), indeterminate. Correlations for the first three excited states were observed at each of the resonances at proton energies of 1588, 1599, and 1620 kev, while those for the next three excited states were observed only at the 1620-kev resonance. The correlations were all in agreement with previously measured $^3/_2{}^-$ assignments to each of these capturing levels and to the ground state of ^{61}Cu. Higher levels were observed at excitation energies of (2.4), 2.64, 2.83, and 3.02 Mev. All energy measurements are accurate to ±30 kev. The double sum-coincidence arrangement which allowed the simultaneous measurement of up to 24 correlation functions is described in some detail. Results are found to be in good agreement with other experimental results. The implications of a reported doublet at about 1.35 Mev are considered with relation to the unusually high quadrupole admixture observed for the 1.37-Mev state. It is shown that the other member of the doublet is not observed in the (p,$\gamma\gamma$) reaction at the resonances studied, and the undetected presence of such transitions could not produce the results observed for the 1.37-Mev state. The results are compared with the reported structure of ^{63}Cu and ^{65}Cu and with the core-excitation model applied to these nuclides. This model does not appear to adequately explain the observations for the 1.37-Mev state, if the observed large value of the quadrupole admixture is a proper index of a high degree of collective motion for this state. (auth)

10343 ELASTIC SCATTERING OF 3.3-Mev POLARIZED NEUTRONS. D. W. Kent (Franklin Inst., Swarthmore, Penna.). Phys. Rev., 137: B401-4(Jan. 25, 1965).

Measurements of azimuthal asymmetry in the scattering of partially polarized neutrons from the D(d,n)^{3}He reaction were carried out for Zn, Se, Sr, Y, and Ag, at a laboratory scattering angle of 90°. The results, combined with values obtained from previously measured elements, are compared with predictions based on a nonlocal nuclear potential. No distinct departure from optical-model behavior is observed. (auth)

10344 FORM FACTORS IN ELECTRON-TRINUCLEON SCATTERING. J. S. Levinger and B. K. Srivastava (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 137: B426-31 (Jan. 25, 1965).

The four form factors in electron-trinucleon (e-^{3}H or e-^{3}He) elastic scattering are analyzed using two alternative sets of four unknowns: (i) the neutron electric form factor, the form factor F_1 for the dominant S state, and the isovector- and isoscalar-exchange magnetic form factors—neglecting the mixed symmetry S′ state; (ii) the form factors F_O and F_L for odd and like nucleons, and the isovector- and isoscalar-exchange magnetic form factors—assuming knowledge of the neutron electric form factor, essentially 0.02 q^2 in the region considered. The first alternative gives positive neutron electric form factors that seem somewhat high; the second alternative gives a plausible value of 1% for the probability of the mixed-symmetry S′ state and also gives a reasonable shape for the isovector-exchange form factor. The isoscalar-exchange form factor stays less than 0.06 nm. There is good agreement between the results for F_1 and calculations based on three different wave functions adjusted to give the experimental Coulomb energy. (auth)

10345 STARK EFFECT ON THE HYPERFINE STRUCTURE OF CESIUM-133. J. D. Feichtner, M. E. Hoover, and M. Mizushima (Univ. of Colorado, Boulder). Phys. Rev., 137: A702-8(Feb. 1, 1965).

The change $\Delta(\mathcal{E})$ in transition frequency of the ($F = 4$, $M_F = 0$) ⟵ ($F = 3$, $M_F = 0$) transition of the ground state of ^{133}Cs as a result of the application of an external electric field $\mathcal{E}$ was calculated theoretically. The effects of differences in the ground-state wave functions due to the hyperfine interaction were included, as well as differences in energy denominators due to hyperfine structure. The calculation gives $\Delta(\mathcal{E}) = -1.9 \times 10^{-6}(1 \pm 0.1)\mathcal{E}^2$ cps, which is to be compared with the experimental value of $-2.29 \times 10^{-6}(1 \pm 0.03)\mathcal{E}^2$ cps, where $\mathcal{E}$ is in v/cm. (auth)

10346 * CORRELATION OF THE MÖSSBAUER ISOMER SHIFT AND THE RESIDUAL ELECTRICAL RESISTIVITY FOR ^{197}Au ALLOYS. Louis D. Roberts (Oak Ridge National Lab., Tenn.), Richard L. Becker, F. E. Obenshain, and J. O. Thomson. Phys. Rev., 137: A895-906(Feb. 1, 1965). (ORNL-P-412)

The Mössbauer isomer shift, which is simply related to the charge density at the Mössbauer nucleus, was measured for pure ^{197}Au and for ^{197}Au as an impurity in Cu, Ag, Ni, Pd, and Pt. Since the isomer shift associated with an impurity and the residual electric resistance due to that impurity are properties of a common conduction-band wave function, one may expect a correlation of the residual resistance with the isomer shift through a suitable model.

Residual-resistance as well as isomer-shift measurements were made at 4.2°K for the above dilute gold alloys. These measurements were correlated through a theoretical model using the residual electric resistivity and the Friedel sum rule to specify the asymptotic wave function at the Fermi level and a pseudopotential which will produce this asymptotic wave function and which is used to continue the s partial wave inward to the gold nucleus at the origin. The correlation of the experimental results using the theoretical model is good if it is assumed that a gold impurity presents an attractive potential to the s partial wave of the host s-band conduction electrons, and if it is assumed the s-band fillings have the values 1, 1, 0.58, and 0.37 for Cu, Ag, Pd, and Pt. (auth)

10347 MULTIPLE-PULSE NUCLEAR MAGNETIC RESONANCE TRANSIENTS IN SOLIDS. P. Mansfield (Univ. of Illinois, Urbana). Phys. Rev., 137: A961-74(Feb. 1, 1965). (COO-1198-205)

The response of a spin system is calculated when a pair of 90° r-f pulses is applied to a set of static identical interacting nuclei, initially polarized in an external static magnetic field. For pulse spacings the order of the spin-spin relaxation time, a solid echo is predicted. This effect is strongly dependent on the relative phasing of the two pulses and is maximized for a 90° phase shift. Extending the work of Powles and Strange, it is shown that the second moment of the nuclear resonance absorption line can be obtained from the solid echo in a straightforward manner, and to a predictable accuracy. A general expression is derived for the principal error term arising in the estimation of the second moment by the solid-echo technique and is applicable to a system of static interacting nuclei of any spin I. Preliminary experimental data shows the presence of solid echoes in powdered aluminum ($I = \frac{5}{2}$). An experimental estimate of the second moment gives $\Delta M_2 = 9.5 \pm 0.2\ G^2$ at 297°K. The effect of two closely spaced r-f 90° pulses was also calculated for a system of static interacting spins composed of two magnetic species. The r-f pulses are assumed to interact with one species only. Some new and interesting effects are predicted, especially in the case when the two pulses are coherent. Unlike a single-spin species where this pulse combination would give zero signal, the presence of the second magnetic ingredient gives rise to a signal the initial slope of which is proportional to the second-moment contribution of the nonresonant spins. Direct measurement of this cross second moment should be very valuable, particularly when scalar interactions are present as well as the dipolar interaction. The automatic removal of the resonant spin contribution to the total second moment would tend to increase the accuracy of a scalar coupling constant determination, particularly if the resonant spin term were dominant. Preliminary experiments on a single crystal of NaF show general qualitative agreement with the predictions. Also calculated is the double-pulse response of a single magnetic species with half-integral spin which has both a dipolar and quadrupolar interaction. The system treated is one of well resolved quadrupole satellites. The r-f is assumed to interact with the central transition only. Kambe and Ollom have calculated the second moment of the steady-state absorption line of the central transition due to dipolar broadening in the case of well-resolved quadrupole structure. It is shown that, as might be expected, the second moment as derived from the free induction decay, when the central line only is pulsed, is in agreement with that of Kambe and Ollom. If a second pulse is applied to the system, in phase with the first, a nonzero signal is predicted, even though this is a single-spin species. It is shown that the growth of this signal is characterized by only part of the dipolar interaction, and a second moment which can be extracted is analogous to the cross second moment of a two-spin-species system. When a scalar interaction is present as well as the dipolar term, the nontrivial fact is shown that for two pulses the interaction measured is no longer a simple fraction of the steady-state second moment. The scalar coupling constants and the dipolar lattice sums are shown to be combined in a different way in each case, so that a double-pulse experiment will yield new information on the spin system. This should certainly help in estimating the scalar coupling constants further than just nearest neighbors. (auth)

10348 RELATION BETWEEN ELECTRON SPIN RESONANCE AND NUCLEAR MAGNETIC RESONANCE IN TRANSITION METAL INTERMETALLIC COMPOUNDS. D. Shaltiel, A. C. Gossard, and J. H. Wernick (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 137: A1027-9 (Feb. 1, 1965).

A single system of intermetallic compounds, $La_{1-x}Th_xRu_2$, was found in which both the nuclear magnetic resonance of ^{139}La and the electron spin resonance of added Gd impurities can be observed. Both the NMR Knight shift and the ESR g shift were measured and found to vary with composition x. Linear relations between g and K and between K and x were found as composition and temperature were varied, from which the effective exchange between spins of the Gd 4*f* electrons and the d electrons of the formula unit was found to be − 0.05 ev. The variations in g and K also allowed the magnitudes of the several sources of magnetic susceptibilities of the compounds to be evaluated. $\chi_{6s}^{spin} \leq 0.07 \pm 10^{-4}$ emu/mole, and χ_{5d}^{spin} varies from 2.0×10^{-4} at 1.4°K to 1.0×1.0^{-4} at 300°K in $LaRu_2$, while the field-induced temperature-independent orbital paramagnetism of the d bands is less than 0.7×10^{-4} emu/mole for the La site in $LaRu_2$ and between 1.8×10^{-4} and 2.4×10^{-4} emu/mole for the Ru site in $LaRu_2$. A reversal in sign of the temperature dependence of the NMR Knight shift as composition was varied is interpreted in terms of changes in the density of electronic states at the Fermi surface as Th is alloyed in place of La. (auth)

10349 COMPLETION OF THE MASS-9 ISOBARIC QUARTET VIA THE THREE-NEUTRON PICKUP REACTION $C^{12}(He^3,He^6)C^9$. Joseph Cerny, Richard H. Pehl, Fred S. Goulding, and Donald A. Landis (Univ. of California, Berkeley). Phys. Rev. Letters, 13: 726-8(Dec. 14, 1964).

The reaction $^{12}C(^3He,^6He)^9C$ is used to measure the mass of ^9C, using a ^3He beam of 65 Mev energy. The measured mass excess (28.95 ± 0.15 Mev) is compared with the prediction of a quadratic equation in T_z, and the two values are found to agree within 0.2%. The implications of this agreement, as applied to charge independence and saturation of nuclear forces, are discussed. (T.F.H.)

10350 NOTE ON THE DECAY OF As^{77}. H. Muenzel, Th. Schneider, and G. Pfennig (Kernforschungszentrum, Karlsruhe, Ger.). Radiochim. Acta, 3: 117-18(Nov. 1964). (In German)

The γ-transitions during ^{77}As decay were investigated. The 240 and 275 kev transitions were found to be coincident. A double level in the 240/250 kev range has to be assumed. (auth)

10351 FISSION OF ^{232}Th BY REACTOR NEUTRONS: FISSION YIELDS OF SOME MASS-CHAINS. A. Wyttenbach, H. R. von Gunten, and H. Dulakas (Eidgenossische Institut für Reaktorforschung, Würenlingen, Switzerland). Radiochim. Acta, 3: 118-21(Nov. 1964).

The cumulative yields of the mass-chains ending at ^{90}Sr, ^{131}I, ^{137}Cs, ^{140}Ba, ^{141}Ce, and ^{144}Ce in the fast neutron-induced fission of ^{232}Th were measured, using radiochemical techniques and, whenever possible γ-spectrum-analysis. (auth)

10352 GRAPHICAL REPRESENTATION OF DOUBLE NEUTRON CAPTURE IN GOLD AND TANTALUM. K. Heydorn (Forsogsinstitut, Atomenergikommissionen, Riso, Denmark). Radiochim. Acta, 3: 161-6(Nov. 1964).

The planning of high flux reactor irradiations for the preparation of radioisotopes, where the effect of multiple neutron capture has to be taken into account, is facilitated by the introduction of a series of graphs representing calculated data for a wide range of fluxes. General formulas for the calculation of activities produced by single and double neutron capture are given, and the validity of various approximations is discussed. Comprehensive calculations are presented for Au and Ta in the flux range from 10^{11} to 10^{15} n/cm^2/sec, graphs being given for maximum activities versus flux together with growth curves for discrete flux values. (auth)

10353 ANGULAR CORRELATION IN Hg^{198}. A. E. Jech, M. L. Ligatto de Slobodrian, and M. A. Mariscotti (Universidad, Buenos Aires). Rev. Union Mat. Arg. Assoc. Fis. Arg., 22: 75-82(1964). (In Spanish)

The angular correlation of the $2' \rightarrow 2 \rightarrow 0$ cascade in ^{198}Hg was measured in order to determine the mixing ratio in the $2' \rightarrow 2$ transition. The obtained result is $\delta = -1.10 \pm 0.35$. Unlike two previous experiments, a liquid source of ^{198}Au was used. The agreement between the present work and the other two showed that the state of the source did not influence the result. (auth)

10354 DETERMINATION OF RECOILLESS FRACTIONS FROM MÖSSBAUER SCATTERING. P. Debrunner and R. J. Morrison (Univ. of Illinois, Urbana). Rev. Sci. Instr., 36: 145-9(Feb. 1965).

The intensity of the recoilless and nonrecoilless resonant scattering of Mössbauer gamma rays for single line Lorentzian energy distributions is calculated. The scattered intensities are expressed in terms of a scattering function which contains the parameters of the scatterer. This scattering function was evaluated for a wide range of values of the recoilless fraction, electronic absorption, thickness, and linewidth of the scatterer. It can be used to determine source and scatterer recoilless fractions from the total scattered intensities. If the recoilless fraction is sufficiently large the recoilless and the nonrecoilless part of the resonantly scattered intensity can be determined, with the aid of numerical calculations given, from a measurement of the transmission of the scattered gamma rays through a resonant absorber. The ratio of the recoilless part of the resonantly scattered intensity does not depend very sensitively upon the properties of the source and can be used to determine unambiguously the recoilless fraction of the scatterer. (auth)

10355 STUDIES ON GAMMA DECAY OF Pr^{143} AND Ho^{165}. Lennart Simons, Asko Anttila, and Solveig Bergstroem (Univ. of Helsinki). Soc. Sci. Fennica, Commentationes Phys.-Math., 30: 18p. (1964).

In ^{143}Pr, a 435 kev gamma ray was found to de-excite the 490 kev level. Angular correlation measurements led to the following tentative spin values for the levels in ^{143}Pr: 725 kev ($^5/_2$, $^7/_2{}^+$), 490 kev ($^5/_2$, $^7/_2$, $^9/_2{}^+$), 350 kev ($^7/_2{}^+$), 57 kev ($^5/_2{}^+$), and the ground state ($^7/_2{}^+$). However, this sequence seems to be in contradiction to the beta decay measurements. The level scheme of ^{165}Ho was confirmed by coincidence measurements. Moreover, the 575 kev gamma was found to feed the 420 kev level. The angular correlation measurements showed that the 716 kev level has a disturbingly long half life for such measurements. The 479 kev gamma ray was found to be almost pure E1. (auth)

10356 A RELATIVE METHOD FOR MEASURING YIELD CURVES OF PHOTONUCLEAR REACTIONS. O. V. Bogdakevich (Lebedev Inst. of Physics, Moscow). Tr. Fiz. Inst., Akad. Nauk SSSR, 19: 167-86(1963). (In Russian)

The directly measured quantity in the determination of photonuclear cross sections is the yield curve $Y(E_m)$, the average of the cross section over the spectrum of γ rays with a maximum energy of E_m. Experimentally the yield curve is determined from $Y(E_m) = c\, N(E_m)/D(E_m)$, where $N(E_m)$ is the number of photonuclear events, c is the detector efficiency, and $D(E_m)$ is proportional to the photon flux. The largest errors in $Y(E_m)$, which usually result from longterm drift in c, may be avoided by a scheme in which E_m is given a step increase ΔE at the end of each synchrotron pulse. During a pulse, E_m may be determined to 0.02% by integrating the time derivative of the magnetic field $\partial H/\partial t$ with a 3-cascade analog integrator. The electronics for the control and measurement of E_m and the vacuum-tube 32-channel analyzer used to register $Y(E_m)$ at the end of each pulse are described. The equipment was calibrated by measuring the thresholds of yield curves for the (γ,n) reactions on Pb, Rh, Cu, Al, and ^{16}O. (TTT)

10357 POLARIZATION MEASUREMENTS OF 6.6-Mev PROTON ELASTIC SCATTERING ON ^{7}Li. I. Grancha, E. A. Romanovskii, and G. F. Timushev (Research Inst. of Nuclear Physics). Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 100(May-June 1964). (In Russian)

A magnetic analyzer and a polarimeter were used for polarization measurements of 6.6-Mev protons elastically scattered by ^{7}Li. Measurements were also made of the angular distributions, and the polarization angular distribution curve was compared with the Rodberg theory. The results showed good agreement with the theory. (R.V.J.)

10358 THE ATOMIC MASSES OF THE STABLE ISOTOPES IN THE REGION RUTHENIUM THROUGH IODINE. Richard Aasen Damerow. Thesis, Minneapolis, Univ. of Minnesota, 1963. 102p.

A sixteen-inch double-focusing mass spectrometer employing the peak matching method of measurement was used to measure the atomic masses of all stable isotopes in the region ruthenium through iodine. The masses of some stable isotopes of xenon were included. Atomic masses of 53 radioactive nuclei were then calculated from mass differences derived from nuclear reaction and β-decay energies. Nucleon binding and pairing energies were calculated from the resulting mass table. The effect of the shell closure at $Z = 50$ on the systematics of nuclear binding and pairing energies was investigated. The discontinuity in proton binding energy is shown to be caused by a decrease in binding energy of protons beyond $Z = 50$ rather than by an anomalously high binding energy at $Z = 50$. This investigation also indicates that the proton shell closure does not influence the systematic behavior of the neutron binding and pairing energies. The binding energies of both neutrons and protons exhibit smooth behavior except for discontinuities at a shell closure. The present atomic masses are also employed to identify the radioactive member of 3 naturally occurring adjacent isobars: ^{115}In$-$^{115}Sn, ^{113}Cd$-$^{113}In, and ^{123}Te$-$^{123}Sb. The present results, coupled with the rules of nuclear stability, unambiguously indicate that ^{115}In, ^{113}Cd, and ^{123}Te should exhibit beta activity or electron capture. The presence of doubly-charged, diatomic tellurium satellites which interfere with the singly-charged peaks is also noted. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10359 DEGENERATE MANY-BODY PERTURBATION THEORY AND THE APPLICATION OF THE REFERENCE SPECTRUM METHOD TO THE NUCLEAR SURFACE. Benjamin Downing Day. Thesis, Ithaca, N. Y., Cornell Univ., 1964. 235p.

In Part One, a linked cluster perturbation expansion is derived for the energies of low-lying states of a many-body system whose unperturbed ground state is degenerate. The formula supplements the usual Goldstone expansion, which holds when the unperturbed ground state is non-degenerate. The derivation is accomplished by using the resolvent method of Hugenholtz, and the result agrees with that obtained previously by Bloch and Horowitz, who used a different procedure. The formula is suitable for treating finite nuclei in which degenerate unperturbed ground states are formed from a closed shell nucleus by adding several particles in the next higher shell. In Part Two, a general discussion is given of how the reference spectrum method for infinite nuclear matter may be modified so as to be useful for calculating the surface properties of nuclear matter. A formula is derived for the reaction matrix in the surface region, and methods are given for evaluating the various terms in the formula. An explicit expression for the surface energy, which is valid to first order in the Brueckner-Goldstone expansion, is also obtained. These results are used to make a calculation of the surface energy of an infinitely large nucleus. (A.G.W.)

10360 DOUBLET SPLITTING IN THE NUCLEAR 1P SHELL DUE TO A SPIN-ORBIT INTERACTION. William Avon Fraser. Thesis, Lincoln, Neb., Univ. of Nebraska, 1964. 67p.

The second order contribution of a two-body spin-orbit interaction to the doublet splitting in ^{15}N and ^{5}He nuclei was estimated. Initially an estimate was obtained by replacing the energy denominators in the Schrödinger perturbation formula for the second order energy shift by a single denominator. For a short range force, the two-body terms so obtained seemed unreasonably large. For this reason a second estimate was made by adding the three- and four-body terms calculated by the single energy denominator method to the exact two-body terms, computed with the Bolsterli-Feenberg technique. The exact two-body terms, while reduced from those of the first estimate, are still strikingly large. The potential parameters used in making the above estimates were, in each case, chosen in two ways. One was to require that the potential resemble, as closely as possible, the Gammel-Thaler phenomenological spin-orbit potential. The other was to require that the splitting obtained by first order perturbation theory be equal to the experimental splitting. With the potentials determined in each fashion both estimates of the second order contribution to the splitting were larger than and opposite in sign to the first order result. The conclusion is drawn that it is unwarranted to attempt to account for the role that the two-body spin-orbit interaction plays in the doublet splitting by a perturbation expansion. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10361 INELASTIC SCATTERING OF NEUTRONS FROM DEFORMED NUCLEI. Richard Donald Koshel. Thesis, Lawrence, Kan., Univ. of Kansas, 1963. 91p.

The cross section is obtained for the inelastic scattering of neutrons from deformed nuclei. The reaction mechanism used is that of the direct interaction. The differential cross section for excitation is obtained upon solving the Schrödinger equation for the problem of a neutron incident upon a deformed nucleus. The interaction is taken to be an optical square well. The shape of the nucleus is described in terms of deformation parameters that indicate the deviation from a spherical shape. A two-channel approximation is made for the wave function. The differential cross section is then obtained in terms of an iteration series. The theory is applied to the special case of a statically deformed nucleus where the excitation is from the ground state of a K = 0 band to the first excited state of the same band. The results are compared with experimental data for the inelastic scattering of neutrons from ^{24}Mg, where the final state is the first excited state. There is good agreement if the results of this calculation are added to a Hauser-Feshbach calculation. It is shown that a direct interaction of an incident nucleon with a collective degree of freedom of a scattering nucleus can give an inelastic differential cross section comparable with that of a statistical calculation and that a more thorough investigation is needed of the competition between direct interaction processes and those of the compound nucleus. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10362 THE BETA DECAY OF La-140 AND A FERMI PLOT COMPUTER ANALYSIS. Roy Acton Parker. Thesis, Baton Rouge, La., Louisiana State Univ., 1964. 74p.

A set of computer programs was devised to perform Fermi plot analyses of beta spectra. These programs were written in FORTRAN II for an IBM 1620 computer, and earlier programs had been written in SOAP IIA for an IBM 650. The programs accept raw beta spectrum data. They execute a calibration of the spectrometer, correct for the half-life of the isotope and substract out background effects. An explicit Fermi function is computed for each datum point, and interpolation from stored tables is unnecessary. The complex gamma function, contained in the Fermi function, is computed to a high degree of accuracy by use of Stirling's approximation or a Taylor's expansion in polygamma coefficients. Allowed or forbidden beta spectra can be analyzed by the Fermi plot analysis programs. A surface barrier type solid state detector was designed to be used as the electron detector in a magnetic double-focusing spectrometer. The beta spectrum of La-140 was investigated. Six beta groups were found: 2.17 Mev, 1.54 Mev, 1.34 Mev, 1.21 Mev, 0.89 Mev, and 0.50 Mev. The 2.17-Mev beta group Fermi plot showed a definite shape. A Kotani form shape factor linearized the Fermi plot, which implies that the transition is a nonstatistical, nonunique, first forbidden transition. Relative intensity and log ft-values were computed for each group. The remaining beta groups are assigned to statistical, nonunique, first forbidden transitions on the basis of the ft-value data. A decay scheme for La-140 is proposed. (Dissertation Abstr., 25: No. 3, Sept. 1964).

10363 STUDIES IN NUCLEAR SPECTROSCOPY BY TWO-NUCLEON TRANSFER REACTIONS. Richard Henry Pehl. Thesis, Berkeley, Calif., Univ. of California, 1964. 160p.

Alpha-particle energy spectra from (d,α) reactions on ^{6}Li, ^{9}Be, ^{12}C, ^{14}N, and ^{16}O were obtained using 24-Mev deuterons. Angular distributions corresponding to resolvable final states are presented. Marked variation in the relative cross section of final states was observed in most of the alpha-particle energy spectra. In an effort to explain the nature of this preferential population these final states are correlated, where possible, with their expected configurations. The present evidence predominantly favors a pickup mechanism, but the relatively large cross section to several levels can be explained more easily by invoking a knockout mechanism. The difficulties involved in using the (d,α) reaction to test the validity of the isotopic-spin selection rule are discussed. An extensive review of the ^{16}O(d,α)^{14*}N (2.31-Mev) transition over a range of bombarding energies is presented. A fairly extensive distorted-wave Born-approximation analysis was carried out for several of the (d,α) transitions studied. Good fits to the alpha-particle angular distributions were obtained. The outstanding characteristic of this analysis was the strong preference for L = 2 transitions relative to L = 0 transitions. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10364 ON THE QUASI-PARTICLE INTERACTIONS IN SPHERICAL NUCLEI. Mannque Rho. Thesis, Berkeley, Calif., Univ. of California, 1964. 186p.

The residual terms that arise from the Bogoliubov-Valatin canonical transformation are studied in angular-momentum representation and applied to some low-energy properties of spherical nuclei. The treatment makes use of the conventional perturbation theory. Its objective is to clarify the roles that each of the interaction terms play, and to understand how it is that the simplied calculations such as the studies by Kisslinger and Sorensen turn out to be so successful. First, the Bardeen-Cooper-Schrieffer theory applied to finite nuclei is reexamined, with a constant-pairing-matrix element approximation (G). It is found for a particular system that within coupling strengths of physical significance, there is only one value of G at which the BCS approxiamtion and an exact number-conserving method coincide whereas at smaller and larger values of G, the two methods deviate in opposite directions. By use of the BCS solutions as the zero-order approximation, the effects of the residual terms on both even-A and odd-A nuclei are analyzed. The results obtained by applying our treatments to single-closed-shell nuclei ($N = 82$ and $52 \leq Z \leq 64$) show that for even-A nuclei, the term H_{22} is sufficient. It appears that for odd-A nuclei, a first-order treatment of H_{31}, together with a complete account of the H_{22} term, gives good results. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10365 SENSITIVITY OF NUCLEAR MATTER BINDING ENERGY TO THE CHARACTERISTICS OF THE TWO-NUCLEON POTENTIAL. Nestor Jalil Azziz. Thesis, University Park, Penna., Pennsylvania State Univ., 1963. 102p.

Using the Moszcowski and Scott approximation to the many-body theory of Brueckner, the sensitivity of nuclear matter binding energy to the characteristics of the two-nucleon potential is studied. The Brueckner-Gammel-Thaler potential (1958) and the Hamada-Johnston potential (1962) were used in the calculations. The contribution to the binding energy of B-G-T potential, which agrees with the experimental value, is greater than the one given by the H-J potential by a factor of almost 2. The main discrepancy between their contributions was found in the two-nucleon state $^{1}P_{1}$. The latter was found to be imprecisely defined by the present two-nucleon data. The nuclear matter binding energy has a marked dependence on the form of the two-nucleon potential. A boundary condition two-nucleon model for nuclear matter is proposed. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10366 DAMPING OF THE GIANT DIPOLE RESONANCE. Mariano E. Bauer. Thesis, College Park, Md., Univ. of Maryland, 1962. 65p.

Because of the high excitation energies involved, in addition to the shell model configurations responsible for the collective behavior of the giant dipole resonance, the particle-hole interaction can admix configurations from the continuum in which a single nucleon contains all the excitation energy. The nucleon energy in the optical well does not correspond to the single particle resonance in view of the interaction energy shift of the dipole state. The distortion of the single-particle wave function is then such that the continuum configuration represents a system in which one particle is not actually a member of the cluster formed by the others. Thus the possibility of damping is introduced. On this basis, partial widths and branching ratios are calculated for the 22.2-Mev and 25.0-Mev levels in ^{16}O. The results agree satisfactorily with the experiment. The present model provides an explanation of the fact that the giant dipole resonance is narrower for closed shell nuclei than for nuclei with valence nucleons. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10367 I. TRIPLE CORRELATION OF THE ^{12}C(p,p′γ)^{12}C REACTION. II. A NEW METHOD OF GAMMA-RAY MULTIPOLARITY MEASUREMENT. Robert Carleton Bearse. Thesis, Houston, Tex., Rice Univ., 1964. 87p.

A triple correlation was performed on the ^{12}C(p,p′γ)^{12}C reaction at the $^3/_2{}^+$ resonance (E_p = 5.37 Mev). Gamma correlations for a set of angles between 0 and 150 degrees were taken for each of a set of proton angles from 40 to 150 degrees. The data were analyzed according to the prescription of Kraus and indicate that the results may be explained assuming a resonant $^3/_2{}^+$ state interfering with a small mixture of $^1/_2$ state. A method of measuring the multipolarity of high energy gamma ray transitions by means of electron-pair energy correlations is proposed. Calculations are presented and discussed. Data for the 0+ to 0+ transition in ^{16}O prepared by the ^{19}F(p,α,π)^{16}O reaction is presented; it is shown that these data are fitted by theory. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10368 THREE-ALPHA DECAY OF C^{12}. Jeff Donaldson Bronson, Jr. Thesis, Houston, Tex., Rice Univ., 1964. 126p.

The reaction ^{11}B(p,2α)^{4}He was studied at proton bombarding energies of 2.0, 2.65, 3.25, 3.73, 4.00, 5.08, and 5.64 Mev. Detection of two of the three final alpha-particles in coincidence permitted discrimination between sequential two-body decay and direct three-body decay. The reaction mechanism was found to be sequential two-body decay involving the ground and the broad first-excited states of ^{8}Be, with events involving the latter showing strong interference effects. These interference effects were attributable to the identity of the three final particles and to the ambiguity of the order of their emission. Not more than 5% of the experimental cross section could be attributed to the direct three-body decay mechanism; indeed, the contribution from the direct process is probably much smaller than the quoted 5%. Also the total cross section for this reaction is of the order of 100 to 200 mb; thus it is comparable to the geometric cross section. These two facts imply that, in this energy region, ^{12}C has a strong cluster configuration of an alpha-particle plus a ^{8}Be nucleus in either the ground or the first-excited state. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10369 HYPERFINE STRUCTURES AND ANOMALY OF Li^6 AND Li^7, AND THE HYPERFINE STRUCTURES OF Re^{186} AND Re^{188}. Richard Guenther Schlecht. Thesis, Berkeley, Calif., Univ. of California, 1964. 83p.

The atomic-beam magnetic-resonance flop-in technique was used to determine the hyperfine-structure separations and the hyperfine-structure anomaly between the isotopes ^{6}Li and ^{7}Li; this technique was also used to measure the hyperfine-structure separations of the isotopes ^{186}Re and ^{188}Re. The separated-oscillatory-field method of Ramsey was used to accurately determine the hyperfine-structure separations in ^{6}Li and ^{7}Li. The result for ^{6}Li is $\Delta\nu_6$ = 228.20528(8) Mc/sec, and for ^{7}Li is $\Delta\nu_7$ = 802.50404(48) Mc/sec. By using these values and the value for the ratio of the g_I's as obtained by Klein, the hyperfine-structure anomaly was determined to be ${}_6\Delta_7 = +1.065(6) \times 10^{-4}$. The errors quoted are four times the statistical errors. The magnetic-dipole-interaction constant, a, and the electric-quadrupole-interaction constant, b, were measured for two radioactive isotopes of rhenium in the J = $^5/_2$ ground state. The values obtained were $a_{186} = \pm 78.3058(24)$ Mc/sec and $b_{186} = \mp 8.3601(50)$ Mc/sec. Therefore, for these hyperfine-structure separations $\Delta\nu_{186}(^7/_2, {}^5/_2) = \pm 265.292(14)$ Mc/sec and $\Delta\nu_{186}(^5/_2, {}^3/_2) = \pm 208.305(14)$ Mc/sec. For ^{188}Re the values obtained were $a_{188} = \pm 80.4320(32)$ Mc/sec and $b_{188} = \mp 7.7455(60)$ Mc/sec. Therefore, for these two hyperfine-structure separations $\Delta\nu_{188}(^7/_2, {}^5/_2) = \pm 273.379(13)$ Mc/sec and $\Delta\nu_{188}(^5/_2, {}^3/_2) = \pm 212.698(17)$ Mc/sec. The nuclear moments of both isotopes were determined to be positive. An improved value for the electronic Landé g factor for rhenium was also obtained, with the result $g_J = -1.95203(8)$. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10370 NEUTRON SPECTRA FROM HEAVY-ION BOMBARDMENT OF GOLD. William George Simon. Thesis, Berkeley, Calif., Univ. of California, 1964. 79p.

Neutron yields from the bombardment of a Au target by 164- and 142-Mev ^{16}O ions were measured at angular intervals of 15 deg from 0 to 165 deg. Neutrons with energy from 0 to 12 Mev were detected by means of nuclear emulsions with use of the internal-radiator method. The 0-deg yield measurements were extended to a neutron energy of 25 Mev by using a polyethylene radiator together with nuclear emulsions for neutron detection. The yields at 164 and 142 Mev are subtracted in order to obtain differential cross sections averaged over this energy interval, which are then transformed to the center-of-mass system. It is known that this reaction leads to fission in most cases, so that the problem of neutron-fission competition arises. The anisotropy coefficient, a, defined by the expression $W(\theta) = 1 + \cos^2\theta$, is about 1 for 2-Mev neutrons and decreases rapidly with neutron energy. The distribution of neutrons is essentially isotropic about 6 Mev. This behavior disagrees with calculations of the angular distribution of neutrons from fission fragments, which are based on measured fragment angular distributions. It is concluded that some neutrons are emitted from the system before fission occurs. Calculations of the ratio of the neutron to fission width agree with this conclusion. The use of the internal-radiator method of neutron detection requires that the escape probability for protons from the emulsion layer be evaluated. Measurements of the multiple scattering of stopping protons, which were used in evaluating this probability, are reported in an Appendix. These measurements are in agreement with theory. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10371 PURE QUADRUPOLE RESONANCE AT LOW TEMPERATURES. Ray Fenton Tipsword. Thesis, Tuscaloosa, Ala., Univ. of Alabama, 1963. 56p.

The pure quadrupole resonance frequency of ^{79}Br and ^{81}Br in $NaBrO_3$ was measured between 4.2 and 77.3°K. The spin-lattice relaxation times were measured between 4.2° and 16°K. The frequency measurements were compared with the Bayer-Kushida theory. While qualitative agreement with the theory is found over the entire temperature interval investigated, the theory does not fit the data in detail. The spin-lattice relaxation times were compared with the theory developed by Chang for $NaClO_3$. If a linear or parabolic temperature dependence of the Br quadrupole frequency is used, the theory can be made to agree with the data by appropriately choosing the Debye temperature. However, if the more nearly correct temperature dependence of the quadrupole frequency given by Bayer is inserted into the theory, it is found that no reasonable adjustment of the Debye temperature gives agreement. Fair agreement with the data can be obtained in this case by adjusting the velocities of the longitudinal and transverse lattice waves. Furthermore, at low temperatures the frequency dependence of Bayer leads to nearly equal contributions to the relaxation of Δm = ±1 and Δm = ±2 transitions, in contrast to the assumption of a linear or parabolic temperature dependence which leads to negligible contribution by the Δm = ±2 transitions. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10372 SPONTANEOUS FISSION-PRODUCED STRONTIUM ISOTOPES IN NATURE. Hirofumi Arino. Thesis, Little Rock, Ark., Univ. of Arkansas, 1964. 106p.

^{89}Sr and ^{90}Sr were separated from kilogram quantities of 17-year-old depleted uranium ($^{238}UO_3$), 14- to 15 year-old natural uranyl nitrate and about 500-million-year-old Katanga pitchblende and exhaustively purified. The activities were counted in CE-14 Tracerlab Low Background Beta Counter. Assuming that the ^{90}Sr in the depleted uranium is formed by spontaneous fission only, the ^{238}U spontaneous fission yield for mass chain 90 was calculated to be 5.9 ± 0.6 per cent. A value of 3.3 ± 0.3 per cent was obtained for the ^{89}Sr yield. About 20 per cent of all the fission events taking place in pitchblende were estimated to be neutron-induced fission of ^{235}U and 80 per cent ^{238}U spontaneous fission. The data indicated that the ratio of induced fission vs. spontaneous fission in nonirradiated natural uranyl nitrate hexahydrate can be as high as 0.3 to 0.4. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10373 CAPTURE OF MUONS IN HELIUM-3. Douglas Roger Clay. Thesis, Salt Lake City, Univ. of Utah, 1964. 129p.

An experiment using negative muons from the synchrocyclotron of the Carnegie Institute of Technology was carried out to measure the rate of the interaction $\mu^- + {}^3He \rightarrow {}^3H + \nu_\mu$ where the produced ^{3}H nucleus is in the ground state. Both the stopping muons and the subsequent 1.9-Mev recoil tritons were measured in a ^{3}He gas scintillation counter operated at 360 psi. A 10% admixture of Xe greatly enhanced the scintillation efficiency and reduced the fraction of tritons leaving the target. Use of a CsI(Tl) crystal above the photomultiplier window and a pulse-shape discriminator circuit precluded the counting of muons stopped in the glass. The gas was contained in a thin-walled Ag box surrounded by a Xe scintillation counter that detected μ-decay electrons. A two-dimensional time and pulse-height analysis was performed on the tritons. Simultaneously, the electrons were time-analyzed with the same apparatus. In a separate run, the Xe concentration in the target counter was increased so that electrons could be counted efficiently in it. An energy resolution of 15% was achieved for recoil tritons, making possible a precise background subtraction. The experimental result, based on about 6800 tritons, is $1470 \pm 67\ sec^{-1}$ and is to be compared with $1505 \pm 120\ sec^{-1}$, the rate expected on the basis of muon-electron universality, conserved vector current hypothesis, and the calculated value of induced pseudoscalar coupling constants. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10374 THEORY OF FINITE NUCLEI. Michel Baranger. p.V1-89 of "1962 Cargèse Lectures in Theoretical Physics." New York, W. A. Benjamin, Inc., 1963.

A review is made of recent developments in many-body theory and a historical survey of nuclear models is presented. The theories of pairing correlations and collective oscillations are developed, and applications to spherical nuclei and doubly closed nuclei such as O^{16}, respectively, are discussed. Problems that possess both pairing and collective aspects are examined: oscillations of nuclei with open shells, moment of inertia, and calculation of nuclear deformation. (L.B.S.)

10375 RECENT RESULTS OBTAINED AT SACLAY. PART II. EXPERIMENTS ON DOUBLE IRRADIATION IN METALLIC SODIUM. M. Goldman (Centre d'Etudes Nucleaires, Saclay, France). p.30-6 of "Electronic Magnetic Resonance and Solid Dielectrics." Amsterdam, North-Holland Publishing Co., 1964. (In French)

Experiments making use of the electronic resonance frequency shift induced by nuclear polarization were performed on metallic sodium, yielding information on the electronic structure of this metal. In a high field, they allowed determination of the electronic density at nuclear sites; in a low field, they contributed to studies of properties of the nuclear spin system: absorption spectrum, spin-lattice relaxation time, and Overhauser effect. (auth)

10376 TARGET FOR A NEUTRON GENERATOR CONSISTING OF A COATING OF ONE OF THE LANTHANON ELEMENTS ON A BASE METAL. R. Redstone and M. C. Rowland (to U. S. Atomic Energy Commission). U. S. Patent 3,167,655. Jan. 26, 1965.

A neutron generator is described in which a beam of energetic ions of hydrogen isotope bombards a target composed of metal impregnated with hydrogen isotope, in which the metal is chosen from the group consisting of Y and the lanthanons. (AEC)

Plasma Physics and Thermonuclear Processes

10377 (AD-421181) A FORTRAN PROGRAM FOR COMPUTING REFLECTION, TRANSMISSION, AND ABSORPTION COEFFICIENTS FOR AN INHOMOGENEOUS PLASMA LAYER. Technical Note R-52. B. H. Kavanaugh, Jr. and J. M. Scarborough (Brown Engineering Co. Inc., Huntsville, Ala.). June 1963. Contract DA-01-009-ORD-1019. 71p. $7.60(OTS).

A FORTRAN computer program is described for computing the transmission, reflection, and absorption coefficients of an inhomogeneous plasma layer. A modified Runge-Kutta integration scheme is used to solve Maxwell's equations for the electric and magnetic fields at the boundary of the plasma layer. (auth)

10378 (AD-602452) NONLINEAR BEAM-PLASMA INTERACTIONS. Technical Report No. 69. J. E. Rowe (Michigan. Univ., Ann Arbor). Mar. 1964. Contract AF33(657)-8050. 78p. $3.00(OTS).

The nonlinear interaction phenomenon involving a beam-plasma-electromagnetic wave combination is investigated using a Lagrangian method to calculate particle trajectories and energy conversion. Although collision effects are neglected finite temperature streams are treated by assigning appropriate particle distribution functions in velocity-phase space. Numerical calculations are presented for multiple stream and beam-plasma configurations with and without propagating slow electromagnetic waves. (auth)

10379 (AD-603901) PLASMA WAVES. E. L. Resler, Jr. and Fred T. Harris (Harry Diamond Labs., Washington, D. C.). June 30, 1964. 35p. (TR-1237). $1.00 (OTS).

The macroscopic theory for a fully ionized gas is presented. A common treatment is given covering certain phenomena of current interest. The equations describing a plasma are derived. Among the phenomena treated are sound waves, plasma oscillations, acoustical damping, magneto-ionic theory, Friedrichs' waves, and cold, collisionless plasma. (auth)

10380 (AEDC-TDR-64-119) CALCULATION OF THE D-C ELECTRICAL CONDUCTIVITY OF EQUILIBRIUM NITROGEN AND ARGON PLASMA WITH AND WITHOUT ALKALI METAL SEED. R. E. Weber and K. E. Tempelmeyer (Arnold Engineering Development Center, Tullahoma, Tenn.). May 1964. Contract AF40(600)-1000. 70p. (AD-602858). $3.00(OTS).

Scalar electrical conductivities were computed for nitrogen and argon plasma in thermal equilibrium. Calculations were made for these gases both unseeded and seeded with cesium, potassium, and NaK in amounts ranging from 0.01 to 10 per cent seed by weight, and cover a range of pressure and temperature from 0.10 to 10,000 atm and from 2000 to 15,000°K, respectively. Calculated electrical conductivities are presented in figure form as a function of temperature with seed rate and pressure as parameters. Some effects of applied magnetic fields up to 20,000 gauss on the conductivity of potassium-seeded nitrogen are also given. (auth)

10381 (AFCRL-63-851) SPECTROSCOPIC MEASUREMENTS ON MAGNETICALLY COMPRESSED HIGH-TEMPERATURE PLASMAS (thesis). Scientific Report No. 1. Goetz K. H. Oertel (Maryland. Univ., College Park). July 1963. Contract AF19(628)-269. 64p. (AD-421595). $7.60(OTS).

A critical investigation of the applicability of Boltzmann factors and Saha equations to a moving inhomogeneous plasma was carried out. Deviations from local thermal equilibrium are discussed and approximate corrections are presented. Time resolved spectroscopic measurements in the visible and ultraviolet regions of the spectrum and high speed photography have been performed on the magnetic compression phase of the preionized plasma with reverse trapped magnetic field in a straight cylindrical single turn coil. The experimental results are compared to predictions as obtained by machine calculations on the basis of a magnetohydrodynamic theory in the two-fluid model. (auth)

10382 (AFCRL-63-899) SMALL AMPLITUDE WAVES AND SCREENING IN DENSE DEGENERATE PLASMA. Scientific Report No. 3. Jack S. Goldstein (Brandeis Univ., Waltham, Mass. Brandeis Astrophysical Inst.). May 24, 1963. Contract AF19(604)-7283. 32p. (AD-424129). $3.60(OTS).

The propagation of electro-acoustic waves in a dense degenerate plasma is considered, for the density range 10^6 to 10^9 g/cc and at temperatures of 10^6 to 10^9°K. Appropriate dispersion relations are obtained, for longitudinal and transverse waves, including the effect of the ion gas. (auth)

10383 (AL-TDR-64-157) FREE AND DRIVEN MODES IN ANISOTROPIC PLASMA GUIDES AND RESONATORS. Robert Likuski (Illinois. Univ., Urbana. Electrical Engineering Research Lab.). July 1964. Contract AF33(657)-10224. 227p. (AD-604087). $6.00(OTS).

Starting with Maxwell's equations containing arbitrary electric and magnetic sources, a set of uncoupled wave equations has been formulated for an anisotropic plasma. Expressions for determining the electromagnetic field components in terms of the solutions of these equations and the transverse currents have been derived and tabulated. Setting the sources equal to zero, the characteristic equations have been obtained for the axially symmetric free modes in a circular cylindrical plasma filled guide, open plasma guide, and coaxial plasma guide. Extensive numerical evaluations of the characteristic equation representing the plasma filled guide have been made for the lowest order mode and a set of omega-beta curves is presented for plasma densities, magnetic fields, phase velocities and guide radii varying from zero to infinity. These curves are compared with a set obtained through the use of quasi-static approximation and with the dispersion characteristics of the right and left hand circularly polarized plane waves in an unbounded plasma. Numerical evaluations are also presented graphically for the open plasma guide and the coaxial plasma guide. (auth)

10384 (CEA-R-2427) SURVOL DES TECHNIQUES MICRO-ONDES POUR L'ETUDE DES PLASMAS. (A Review of Microwave Techniques in Plasma Studies). Terenzio Consoli (France. Commissariat â l'Énergie Atomique. Centre d'Études Nucleaires, Saclay). Oct. 1964. 79p. (CONF-83-2) Dep.(mn).

From International URSI Conference, Tokyo, Sept. 1963.

The problem of the application of microwave techniques to the study of plasma properties is considered. Fundamental laws concerning the theory of waves in an ionized medium, as well as measurable effects of transverse and longitudinal propagation, are summarized. Experimental methods and various measurements that may be effected in very high frequency plasmas are reviewed. Microwave techniques dealing with longitudinal propagation and in particular with propagation along a right mode are studied. (auth)

10385 (CLM-R-41) THE CENTRAL REGIONS OF THE DIFFUSE PINCH. M. G. Rusbridge (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Oct. 1964. 17p. Dep.; $0.50(BIS), 2s. 6d.(HMSO).

The structure and properties of the central regions of cylindrical diffuse pinch configurations are investigated in general terms using an expansion in powers of the radius. The discussion is then limited to discharges marginally stable near the center. The evolution with time of the central regions due to dissipative processes such as ohmic heating and thermal conduction is discussed. It is shown that under some conditions the discharge will instantaneously become unstable. When dissipative processes are neglected, the discharge can change only if the boundary conditions change, and the influence of these changes on the central regions is discussed. The results are relevant to the problem of setting up such a configuration in a time short compared with typical diffusion times. Finally the possibility is investigated of using the results, which strictly refer only to the central regions, as a guide in constructing models of the whole discharge. As an example a particular configuration is constructed which is hydromagnetically stable and contains a pressure giving a β of 35%. (auth)

10386 (CONF-471-45) HIGH-PERVEANCE ELECTRON BEAM-PLASMA INTERACTION: REPORT ON AN EXPERIMENT IN THE LONG SOLENOID FACILITY AT OAK RIDGE NATIONAL LABORATORY. W. D. Getty (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). Dec. 16, 1963. Contract W-7405-eng-26. 25p.

From American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963. Dep.(mn); $1.00(cy), 1(mn) OTS.

An attempt is made to heat plasma electrons, using a high-current dense electron beam, to such high temperatures that the plasma electrons cannot interfere with the excitation of ion oscillations in the plasma by the same electron beam. Under certain conditions energetic (10 to 100 kev) ions are detected, but large-scale heating is not observed. The phenomena associated with the excitation and detection of the ion oscillations are described in detail. (T.F.H.)

10387 (IPP-1/30) MESSUNG DER LOKALEN ELEKTRONENTEMPERATUR UND ELEKTRONENDICHTE IN EINEM Θ-PINCH MITTELS DER STREUUNG EINES LASERSTRAHLS. (Measurement of the Local Electron Temperature and Electron Density in a Θ-Pinch Using the Scattering of a Laser Beam). H. J. Kunze (Institut fur Plasmaphysik, G.m.b.H., Garching, Germany). Oct. 1964. 49p. Dep.(mn).

The development of light scattering by a plasma, as a diagnostic method that allows the local measurement of electron density and electron temperature, is reported. After a résumé of theoretical results, the feasibility of scattering experiments is discussed. Lasers are apparently needed. One crucial factor of these experiments is the self-luminosity of the plasma. Therefore the ratio of scattered radiation to plasma radiation is estimated. For the case in which this ratio is smaller than one a differential method to eliminate the plasma radiation is explained. The experimental setup is described. Using fiber optics it was possible to measure the whole spectrum of scattered light by one pinch discharge only. Several types of obtained spectra are modified by collective effects between the particles in the plasma. The building up of satellite lines in the spectra is found, as well as the existence of a small central line, as was predicted by the theory. Absolute calibrations of intensities also show the decrease of the scattering cross section. The use of Rayleigh scattering by neutral atoms for the calibration of the arrangements is mentioned. From the spectra plasma parameters could be derived. (auth)

10388 (IPP-2/33) ION WAVES IN AN INHOMOGENEOUS PLASMA. N. D'Angelo (Institut für Plasmaphysik, G.m.b.H., Garching, Germany). Dec. 1963. 31p. Dep. (mn).

Calculations are carried out for the propagation of ion waves, which have frequencies of 10 to 30 kc, in Cs and K thermal plasmas, for the case of propagation at an arbitrary angle with respect to the stationary magnetic field. The effects of ion and electron drifts along the magnetic field are also taken into account. (T.F.H.)

10389 (IPP-6/16) THEORIE DER PLASMA-RESONANZSONDE. (Theory of Plasma Resonance Probles). H. K. Wimmel (Institut für Plasmaphysik, G.m.b.H., Garching, Germany). Mar. 1964. 24p. Dep. (mn).

The longitudinal h-f field produced by an external voltage was derived for a one-dimensional plasma-layer model from the linearized macroscopic plasma equations (with damping). The electron direct current to the probe was numerically calculated, in which the motion of collision-free individual particles in combined direct and h-f fields was investigated approximately. An approximation value for the layer thickness was assumed from the Langmuir-Child law. A direct current resonance was shown at $\omega_{res} < \omega_p$, but no resonance at $\omega = \omega_p$. The results agree qualitatively with experimental results. Data in opposition to the validity of the theory of resonance probes were cited. (tr-auth)

10390 (IPP-6/27) ABSORPTION COEFFICIENT OF RUBY-LASER RADIATION IN FULLY IONIZED LIGHT ELEMENTS. Heinrich Hora (Institut für Plasmaphysik, G.m.b.H., Garching, Germany). Sept. 1964. 36p. Dep. (mn).

Starting from the linearized macroscopic equations of the two-fluid-model, the absorption coefficient and refractive index of a fully ionized plasma are calculated for atomic numbers $Z = 1$ to 10, electron temperatures $T = 10^1$ to near 10^5 ev, atomic densities $N = 10^{17}$ to 10^{23} cm^{-3}, and for a light frequency $\omega = 2.71 \times 10^{15}$ sec^{-1} (ruby laser). A linear interaction between field and plasma is assumed. Although only the d-c collision frequency is used, the resulting optical constants are in good agreement with values based on a microscopic theory, and with absorption coefficients calculated from bremsstrahlung theory. In the latter case the light frequency must be much higher than the plasma frequency, and agreement is only possible when stimulated emission is taken into account in the bremsstrahlung calculations. (auth)

10391 (MATT-296) PARTICLE CONFINEMENT TIMES IN THE ROTATING PLASMA OF THE B-3 STELLARATOR. J. G. Gorman (Princeton Univ., N. J. Plasma Physics Lab.). Aug. 1964. Contract AT(30-1)-1238. 17p. (CONF-641108-1). Dep.(mn); $1.00(cy), 1(mn) OTS.

From American Physical Society, New York.

Highly ionized deuterium plasmas having temperatures of 5 ev and peak densities of 2×10^{13} cm^{-3} are rotated with velocities up to 1.5×10^6 cm/sec by means of a probe-imposed radial electric field. Above a minimum rotational velocity, the particle confinement time in plasmas having the same rotational velocity is found to be proportional to the square of the magnetic confining field. The results are compared with the "diffusive equilibrium" model. (auth)

10392 (MATT-Q-21) ANNUAL REPORT [ON PROJECT MATTERHORN], JANUARY 1–DECEMBER 31, 1963. (Princeton Univ., N. J. Plasma Physics Lab.). Apr. 17, 1964. Contract AT(30-1)-1238. 420p. Dep.; $5.00(OTS).

Progress is reported in research with the model C Stellerator, experiments with small plasma devices, plasma stability theory, wave-plasma phenomena, and research and development in engineering and physics. (J.R.D.)

10393 (NASA-TN-D-2536) GRAPHICAL RESULTS FOR LARGE-AMPLITUDE UNSTEADY ONE-DIMENSIONAL WAVES IN MAGNETIZED COLLISION-FREE PLASMAS WITH DISCRETE STRUCTURE. William Prichard Jones and Vernon J. Rossow (National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.). Jan. 1965. 84p. $3.00(OTS).

Structure of the compressed layer of gas behind one-dimensional time-dependent large-amplitude waves moving across a collisionless fully ionized magnetic plasma is studied by computer codes. Data from these codes are processed by an automatic digital-to-analog plotter and presented graphically in several formats that make it possible to observe special characteristics of the development of collisionless shock waves. Cases considered in the first sequence of solutions illustrate the variation of the structure of the flow field with Alfvén Mach number of the shock front. Changes brought about in these flow fields when the driving and ambient magnetic fields are assumed to be of opposite sign are then studied. Wave forms that result when two identical collisionless shock waves collide are presented for two special situations. The effect of the mass ratio of the two charged species and the temperature of the ambient plasma on the structure of the magnetic field in the flow field is also considered. These graphical results indicate that a smooth, orderly wave form is achieved only for compression waves in which the Alfvén Mach number of the front is less than approximately 2 but greater than 1 and the ambient plasma temperature is very small. When the Alfvén Mach number is greater than 2 or the initial temperature of the gas is not negligible, the disturbance produces a field that has a spatially irregular and disorganized form. The structure and velocity of the wave front is then markedly time dependent. Solutions in the strong-disturbance regime appear to be so individualistic that only gross features are attributable to the strong-family solutions as a whole. (auth)

10394 (NASA-TN-D-2571) SOME TRANSIENT ELECTRICAL CHARACTERISTICS OF THE EXHAUST OF A SELF-CROWBARRED COAXIAL PLASMA GUN. Charles J. Michels (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Jan. 1965. 16p. $1.00(OTS).

An experimental investigation of the discharge from a self-crowbarred coaxial plasma gun was performed by using Rogovsky loops, framing and streak cameras, and magnetic-field probes. The discharge appears first as a weak-intensity diffuse plasma puff, whose velocity, as determined from streak-camera photographs, is the same as the velocity of the current front, as determined by magnetic probes in the gun annulus. Its location coincides with the extrapolated location of the current front. A short time later, an intense well-collimated elongating luminous core of plasma appears from the tip of the center electrode. The velocity of this core front is slightly less (and diminishing with time) than the current-front velocity. Rogovsky loop measurements indicate that this core is part of a closed current path between the gun electrodes and is current-carrying at a point well downstream of the muzzle. (auth)

10395 (NSL-62-105-5) PLASMA PROPERTIES BY MOMENTUM CHANGE. P. D. Lenn and D. L. Ward (Northrop Corp. Northrop Space Labs., Hawthorne, Calif.). May 1964. Contract AF49(638)-1160. 98p. (AD-603097; AFOSR-TDR-64-1000) $3.00(OTS).

The use of the momentum change technique to determine average properties of a plasma from its interaction with applied electric and magnetic fields was investigated. Experiments were performed using a linear crossed field accelerator. An analysis for the calculation of average values of the scalar conductivity, Hall coefficient, and ion slip coefficient is developed and applied to experimental results obtained with argon at 2, 4, and 8 mm Hg. From those values, the electron temperature and number density and the mean electron-ion collision time were calculated. Assuming a relation between the electron and heavy particle temperatures, the heavy particle densities, the mean ion-atom collision time, and the ion-atom collision cross section were calculated. The experimental and total uncertainties of the results are estimated. The results are compared for consistency with possible equilibrium and nonequilibrium states. The results were found to have slightly better than order of magnitude accuracy and to be consistent, within that degree of accuracy, with possible equilibrium states. (auth)

10396 (R64SD-70) THEORY OF NON-EQUILIBRIUM IONIZATION IN WET ALKALI METAL VAPORS–CONTINUOUS CHANGING MODEL. John M. Smith (General Electric Co. Missile and Space Div., Valley Forge Space Technology Center, King of Prussia, Penna.). Oct. 1964.

Contracts AF33(657)-8298 and AF49(638)-914. 30p. (AD-608093).

A theory for non-equilibrium ionization in wet alkali metal vapor is formulated. The media are considered to consist of electrons, neutral gas atoms, positively charged atomic ions, and charged vapor droplets. The degree of ionization of the gas atoms is assumed to be given by Saha's Law evaluated at the electron temperature while the degree of charging of the vapor droplets is obtained by equating the random electron current in the gas to the thermionic emission current of the vapor droplet at its internal temperature. The electron temperature is determined by equating the Joule heating rate of the electrons to their rate of energy loss due to elastic electron-atom, electron-ion, and electron-droplet collisions and inelastic electron-droplet collisions. The droplet internal temperature is determined by equating the rate of droplet heating due to electron bombardment to the rate of cooling due to atom and ion bombardment. The above theory is applied to MHD generator considerations for which the predominant effect of the droplets is found to be the absorption of free electrons from the system accompanied by an increase in magnetic field requirements. The depression of electron density is found to be most severe at high percent moisture and for small droplets. (auth)

10397 (RADC-TDR-64-174) PLASMA KINETIC ENERGY-RF CONVERSION. Final Report. (Advanced Kinetics, Inc., Costa Mesa, Calif.). July 1964. Contract AF30(602)-2981. 80p. (AD-604120). $3.00(OTS).

A theoretical and experimental program is described, aimed at studying the possibility of extracting microwave power from the kinetic energy of a plasma. The appropriate theoretical framework is established. Detailed experiments were run at X-band and at K-band. The detected microwave pulse appears before onset of opacity and attains values on the order of 50 to 250 mw for a background pressure of 20 microns Hg, discharge voltages around 20 kv, and magnetic fields around 3.5 kG. The output is studied as a function of magnetic and electric field. At K-band two peaks become apparent, and these are interpreted in terms of the fundamental and the second harmonic detected in this frequency interval. It is shown that the power output detected is too high to be explained by cyclotron radiation output from a population of temperature and density not exceeding reasonable values. The mechanism of electron acceleration by overstability processes is introduced, which would seem to explain the high radiation output as the cyclotron radiation from very high speed electrons accelerated by internal processes in the plasma. (auth)

10398 (TID-21189) VISIT OF U. S. CONTROLLED-FUSION RESEARCH TEAM TO THE U.S.S.R., FEBRUARY 9–23, 1964. Chester M. Van Atta, ed. (California. Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 200p. Dep.; $6.00(cy), 4(mn) OTS.

The theoretical and experimental Soviet programs in plasma physics and controlled thermonuclear reactions are described, as observed by a team of U. S. scientists. The work in progress at the various research centers is described individually for each center. (T.F.H.)

10399 (JPRS-27372(p.1-4)) INSTABILITY OF RADIAL PINCH PLASMAS. Hsu Fu. Translated from K'o Hsueh T'ung Pao, No. 8, 706-7(1964).

The instability of motion of the pinch effect is studied within the "snow-plow" model. It is then shown that instability with respect to radial motion is not only related to acceleration, but also to velocity and other factors. The radial instability is thus concluded to be inequivalent to the Rayleigh–Taylor instability for plane motion. (T.F.H.)

10400 (UCRL-Trans-1133(L)) STABILIZATION AND CONFINEMENT OF PLASMA BY HIGH-FREQUENCY ELECTROMAGNETIC FIELDS. A Review of Experimental Studies. S. M. Osovets (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Translated by T. Watt (Univ. of California, Lawrence Radiation Lab., Livermore), from report IAE-665. 1964. 52p. Dep.(mn); $3.00(cy), 1(mn) OTS; $5.60(fs), $1.76(mf) JCL.

Methods of influencing plasma by high-frequency fields are studied. These methods differ substantially both in principle and in practice. However, all experiments carried out so far indicate unambiguously that such fields do have a stabilizing effect on the principal instabilities, and that they can give rise to equilibrium configurations. (auth)

10401 (UCRL-Trans-1134(L)) TURBULENT HEATING AND STABILITY OF HIGH-TEMPERATURE PLASMA. M. V. Babykin, P. P. Gavrin, B. A. Demidov, et al. (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). Translated by T. Watt (Univ. of California, Lawrence Radiation Lab., Livermore), from report IAE-667. 1964. 65p. Dep.(mn); $3.00(cy), 2(mn) OTS; $6.60(fs), $2.15(mf) JCL.

Turbulent heating of plasma is reviewed. The stability of dense hot plasma in the case of an adiabatic compression is investigated. A plasma with $nT_e \sim 10^{15}$ ev/cm^3 was obtained as a result of turbulent heating. Adiabatic compression of such plasma was used to achieve $T_e \sim 30$ kev and $T_i \sim 3$ kev. The plasma was found to be stable for 2 milliseconds and about 10^5 neutrons per pulse were observed at the magnetic field maximum. A theory of turbulent heating is proposed, and results of experiments on a toroidal apparatus with an electric field of up to 200 v/cm, parallel to the magnetic field, are described. Anomalous plasma resistance was observed in these experiments. It is shown that this method of heating is capable of producing ion temperatures of 50 to 100 kev at a density of $\sim 10^{14}$cm^{-3}, and confinement times of up to 1 sec. (auth)

10402 A RELATIVISTIC FLUID SPHERE RESEMBLING THE EMDEN POLYTROPE OF INDEX 5. H. A. Buchdahl (Australian National Univ., Canberra). Astrophys. J., 140: 1512-16(Nov. 15, 1964).

The classical polytrope of index 5 is a gravitating fluid sphere in hydrostatic equilibrium, when the equation of state of the fluid is $p/p_c = (\rho/\rho_c)^{6/5}$, where ρ is the density, p the pressure, and the subscript c denotes central values. An analogous solution of the relativistic field equations is presented, the equation of state being now $p/p_c = (\rho/\rho_c)^{6/5} \{1 + 2q_c[(\rho/\rho_c)^{1/5} - 1)]\}^{-1}$, where $q = 3p/\rho c^2$, and ρc^2 is the energy density ($=T_4^4$). The correspondence between the classical and the relativistic distribution is considered in some detail. (auth)

10403 NON-RADIAL OSCILLATIONS OF GASEOUS MASSES. S. Chandrasekhar and Norman R. Lebovitz (Univ. of Chicago). Astrophys. J., 140: 1517-28(Nov. 15, 1964).

The fundamental frequencies of nonradial oscillations of polytropic gas spheres, belonging to spherical harmonics of orders $l = 1$ and 2, are evaluated, in a second approximation, by a variational method. Also, the value of the ratio of the specific heats γ is determined for which an accidental degeneracy occurs between the fundamental modes of radial and nonradial oscillation belonging to $l = 2$; it is found that this value of γ varies from 1.6 for a homogeneous compressible sphere to 1.5719 for a polytrope of index $n = 3$. (auth)

10404 ON THE OSCILLATIONS AND THE STABILITY OF A HOMOGENEOUS COMPRESSIBLE CYLINDER. J. Ostriker (Yerkes Observatory, Williams Bay, Wis.). Astrophys. J., 140: 1529-46(Nov. 15, 1964).

The stability of a homogeneous cylinder is investigated by the method of small oscillations and normal modes. The normal modes with motions in the (ϖ,ϕ) directions are treated exactly, and the modes with motions in the (ϖ,z) directions are treated by Chandrasekhar's variational principle. In addition to the stable modes there are, as anticipated, convectively unstable solutions for each cylindrical harmonic. The varicose (sausage) instability does not exist as a separate mode but appears to enhance the instability of the convective modes. Graphical and tabular material shows the characteristic frequencies and proper solutions of the axisymmetric modes for selected values of γ. (auth)

10405 CONFINEMENT OF PLASMA IN A TRAP WITH A COMBINED MAGNETIC FIELD. M. S. Ioffe and R. I. Sobolev. At. Energ. (USSR), 17: 366-75(Nov. 1964). (In Russian)

A study was made of the containing properties of an adiabatic trap with a magnetic field increasing in the longitudinal and radial directions. This field is obtained from a combination of a field of the usual screw configuration (basic field $H_0 ||$) and a field of a system of conductors distributed parallel to the axis of the trap (stabilizing field $H_{\perp}$). The conductors are placed equidistantly around the lateral wall. The trap was filled with plasma with a density $n \approx 10^9$ to 10^{10} cm^{-3} and protons of energy ≈ 5 kev. The dependence of the plasma lifetime on the value of $H_{\perp}$ and on the neutral gas pressure was measured. It was concluded that such a combined field provides stable confinement of plasma, undisturbed by magnetohydrodynamic instability (at least for $\beta = nI/(H^2/8\pi) \approx 10^{-4}$). The control of the instability is confirmed by an analysis of the plasma oscillation at various values of $H_{\perp}$. The plasma decay is determined by the charge exchange of fast ions in the residual gas; the maximum times of containment achieved are 0.06 sec for $p = 7 \times 10^{-9}$ mm Hg. A qualitative picture of the plasma density distribution according to trap radius was obtained. (tr-auth)

10406 A SOLUTION OF THE FOKKER-PLANCK EQUATION FOR HOMOGENEOUS PLASMAS. F. J. Jankulak, L. G. de Sobrino and Y. K. S. Tam (Univ. of British Columbia, Vancouver). Can. J. Phys., 42: 1743-50(Sept. 1964).

The linearized Fokker-Planck equation for homogeneous and isotropic plasmas is solved by using the Raleigh-Ritz variational procedure. The problem is considerably simplified when only dominant terms in the ratio of the electron mass to the positive ion mass are taken into consideration. The results are compared with the solution of the Balescu-Guernsey-Lenard equation obtained by Rosenberg and Wu. The agreement of the solutions can be taken as a justification for the use of the Fokker-Planck equation for homogeneous plasmas. (auth)

10407 UNIFORMLY VALID SOLUTION OF THE FLOW EQUATIONS IN A PLASMA ACCELERATOR WITH PROGRESSIVE WAVES. Roger Peyret (Institut Henri Poincare, Paris). Compt. Rend., 259: 2592-5(Oct. 19, 1964). (In French)

The solution obtained previously (Compt. Rend., 259: 1810 (1964)) by the classical technique of linearization was not uniformly valid. Therefore a method of standardization was applied that leads to a solution consisting of a mean flow on which small oscillations are superposed. (tr-auth)

10408 VARIATIONAL PRINCIPLE FOR THE STABILITY OF A QUASI-NEUTRAL PLASMA. Jean Andreoletti (Euratom-CEA, Fontenay-aux-Roses, France). Compt. Rend., 259: 2617-20(Oct. 19, 1964). (In French)

On the basis of a dynamics with two adiabatic invariants, the variational principle of Kruskal Oberman was demonstrated. By taking the electrostatic field and the relation of quasi-neutrality into consideration, a near variational principle was obtained. This principle is, in general, less severe than that of Kruskal Oberman. (tr-auth)

10409 LOCAL MEASUREMENT OF THE ELECTRON TEMPERATURE IN A PLASMA POSITIVE COLUMN WITH THE HELP OF MICROWAVE-STROBOSCOPIC METHOD. J. Prostějovský (Charles Univ., Prague). Czech. J. Phys., 14: 796-8(1964). (In German)

A microwave-stroboscopic method for determining the electron temperature in a plasma is described, based on measurements of the instantaneous noise temperature in a short section (1 mm) of a plasma positive column. A diagram of the experimental arrangement is presented. (L.B.S.)

10410 THE INFLUENCE OF PROBE POTENTIAL ON THE ELECTRON ENERGY DISTRIBUTION IN A PLASMA. E. H. Hirsch (Weapons Research Establishment, Salisbury, South Australia). J. Electron. Control (1), 17: 481-9(Nov. 1964).

The electron energy distribution in a hot-cathode low-pressure discharge was measured by a probe and an electrostatic energy analyzer. Probe data indicate a non-Maxwellian primary group and two Maxwellian electron groups of lower energy, but the analyzer spectra show no Maxwellian groups. It is found that the probe potential can modify the number and energy distribution of electrons incident on the probe, and this effect is suggested as an explanation of the Langmuir paradox. (auth)

10411 THE DAMPING OF DIPOLE RESONANCES OF A PLASMA COLUMN. R. N. Franklin (Oxford Univ.). J. Electron. Control (1), 17: 513-20(Nov. 1964).

Experiments are reported in which the subsidiary resonances of a plasma column arising from electron standing waves in the column were examined in comparison with the principal resonance (when the column behaves essentially as a dielectric medium). It is shown that radiation damping is effective in the scattering of microwaves from the column for the subsidiary resonances, but that the motional damping of the waves is not simply related to the electron collision frequency. (auth)

10412 THE STRUCTURE OF THREE-DIMENSIONAL HYDROMAGNETIC WAVES IN A UNIFORM COLD PLASMA. Tsutomu Tamao (Tohoku Univ., Sendai). J. Geomagnet. Geoelec., 16: 89-114(1964).

Characteristics of the three-dimensional hydromagnetic waves caused by a local source in a uniform cold plasma are studied. There are two modes of hydromagnetic waves. One is an isotropic mode which spreads in all directions from the source and transmits the disturbance in the magnetic field component parallel to the field lines. The other is a mixed transverse mode consisting of two parts, the pure and the converted transverse modes, and transmits the signals of the normal field components. It is emphasized that the former part is a one-dimensional wave propagating parallel to the lines of force through the source region, while the latter is the converted one-dimensional wave from the three-dimensional isotropic mode with geometrical attenuation. Space-time relations for disturbances belonging to the converted mode are obtained. The structures of hydromagnetic waves generated by particular external forces, the partial compression and the azimuthal drag, are also presented. For the case of reflection of the transverse wave on the anisotropic conducting sheet, the quantitative relation between the incident electric field and the induced currents in the sheet is shown. Furthermore, space and time variations of hydromagnetic oscillations excited by the azimuthal stress and confined within the region between two parallel infinitely conducting solids are illustrated. A qualitative discussion of some geomagnetic disturbances is given with respect to the properties of three-dimensional hydromagnetic waves. (auth)

10413 NEGATIVE ION EFFECTS ON WHISTLER MODE PROPAGATION. Jack Smith (Univ. of Arizona, Tucson). J. Geophys. Res., 70: 53-9(Jan. 1, 1965).

Expressions for group and phase velocity are derived for left- and right-hand circularly polarized waves propagating along the static magnetic field of a magnetoplasma composed of electrons, positive ions, and negative ions. It is shown that a small percentage of negative ions can have pronounced effects on the propagation characteristics of the right-hand wave near the negative ion gyrofrequency. The wave becomes evanescent in a frequency band just above the gyrofrequency and exhibits a nose effect below the gyrofrequency. Above the stop band the wave's group velocity is strongly influenced by the negative ions. Some experimental observations consistent with negative ion effects are discussed. (auth)

10414 ON THE POSSIBILITY OF BIREFRINGENCE IN A MOVING PLASMA. Richard A. Ferrell (Univ. of California, Berkeley). J. Geophys. Res., 70: 243-4(Jan. 1, 1965).

A re-examination is made of a calculation by Lusignan indicating that the velocity of propagation of electromagnetic radiation in a moving plasma depends on the direction of polarization. This calculation is reconciled with the requirement of no birefringence imposed by special relativity. (M.J.T.)

10415 PERTURBATION THEORY OF MICROWAVE INTERACTION WITH GYROELECTRIC PLASMAS. Elliott R. Nagelberg (Bell Telephone Labs., Inc., Whippany, N. J.). J. Math. Phys. (N. Y.), 6: 44-50(Jan. 1965).

As a means of determining the effects of a uniform but arbitrarily directed magnetic field on cylindrical and spherical wave propagation in a cold, homogeneous plasma, the magnetic field is treated as a small perturbation. An expansion for the electric and magnetic fields in powers of the parameter $i\omega_g/\omega$, where ω_g is the static gyrofrequency of the electron, is assumed, and the linear terms are solved for. This solution is carried out under the assumption that the fields are known for the limit of vanishing static magnetic field. The first-order theory is then applied to cylindrical and spherical systems. When the approximate solution for the axially magnetized column is compared with the exact result, agreement is obtained provided that the static magnetic field is weak. (auth)

10416 STOPPING POWER OF AN UNSTABLE PLASMA. Jun-ichi Okutani and Osamu Aono (Tokyo Univ.). J. Phys. Soc. Japan, 19: 2207-9(Nov. 1964).

The rate of energy loss of a charged particle moving through an unstable plasma is discussed as an initial value problem under the assumption that there are no other causes of disturbances than the charge itself. The plasma is assumed to be composed of two streams of electrons. When the speed of the charge exceeds those of the streams, the stopping power tends to a finite limit, as time passes, without any influences of the instability. A steady solution is also obtained. (auth)

10417 EXCITATION OF ION ACOUSTIC WAVES IN A UNIFORM MAGNETIC FIELD. Michio Matsumoto (Tokyo Inst. of Tech.). J. Phys. Soc. Japan, 19: 2210-14 (Nov. 1964).

Ion acoustic waves propagating in a collision-free plasma at an arbitrary angle with a strong, uniform magnetic field B_0 are investigated. The plasma is assumed to consist of two components with Maxwellian velocity distributions which have different drift velocities along B_0. The dispersion relation derived from the Boltzmann-Vlasov and Poisson equations is studied by a graphical method. Stable and unstable regions of these waves are shown to be slightly different from those of the waves propagating along B_0. The structure of the regions is also indicated by lines of constant frequency and constant growth rate. (auth)

10418 INSTABILITIES IN THE SLOW THETA PINCH BY MAGNETIC FIELD ASYMMETRY. Tetsu Miyamoto and Haruyuki Ohnishi (Nihon Univ., Japan). J. Phys. Soc. Japan, 19: 2237(Nov. 1964).

A slow theta pinch experiment was carried out in helium gas of 50 and 200 mtorr without preheating. The coil had a mirror ratio of 1.4, and the peak field of 11 k gauss was reached in 20 μsec. The plasma column was formed along the line of force near the chamber axis. Then it starts to drift toward the magnetic axis just after the axial contraction. The drift velocity was 1 to ~ 3×10^5 cm/sec at 50 mtorr. Instabilities of slow growth rates appeared in this drift process. The typical example was the fission instability. It appeared most apparent in later half cycles where the drift velocities were large. The plasma rotates on the magnetic axis in the direction of the electron gyration in the driving field with the angular frequency of 10^5 Rad/sec. It is proposed that the fission and some other instabilities with slow growth rates are brought about by the magnetic field asymmetry. (C.E.S.)

10419 AXIAL MOTION AND END LOSS IN THE SLOW THETA PINCH PLASMA. Shoichi Shiina, Haruyuki Ohnishi, and Masahiro Yokota (Nihon Univ., Japan). J. Phys. Soc. Japan, 19: 2242-3(Nov. 1964).

Experiments on a slow theta pinch were carried out in helium in the pressure range of 5 to ~ 300 mtorr without preheating. The time resolved electron temperatures were measured by means of the intensity ratio of the helium singlet and triplet lines. It is shown that the axial contraction produces a heating effect and that the end loss plasma has a lower temperature than that of the confined plasma. (C.E.S.)

10420 APPLICATION OF D.C. PLASMA ARC HEATING TO HYPERSONIC PROPULSION TESTING. S. D. Raezer, E. A. Bunt, and H. L. Olsen (Johns Hopkins Univ., Silver Spring, Md.). J. Spacecraft Rockets, 1: 155-60 (Mar.-Apr. 1964).

As propulsion testing is undertaken at lower altitudes and higher Mach numbers, the requirements of correct static temperature and pressure simulation and uniform flow in a test section of practical size lead to stagnation temperatures too high to be produced by storage-type heaters. For this reason, a 10-Mw d-c plasma arc heater was developed for use with a Mach 7 to 10 tunnel. Thermal efficiencies exceeding 60% were achieved at useful flight simulation conditions. The design principles and operating characteristics of the integrated arc heater and hypersonic propulsion tunnel are described in some detail. (auth)

10421 INVESTIGATION OF MAGNETOHYDRODYNAMIC FLIGHT CONTROL. William B. Ericson and Algirdas Maciulaitis (Grumman Aircraft Engineering Corp., Bethpage, N. Y.). J. Spacecraft Rockets, 1: 283-9(May-June 1964).

Results are presented of an investigation into the use of a magnetic field in the nose region of a hypersonic vehicle as a means of flight control. The vehicle is assumed to be moving at speeds that cause shock ionization of a significant portion of the shock layer. The altitude-speed regimes in which this ionized flow will strongly interact with a magnetic field are determined. The governing interaction parameter Q′ is based essentially on the shock standoff distance. The magnetohydrodynamic control forces, which can be generated within these large interaction regimes ($Q' > 1$), are computed. It is shown that the critical portion of a typical flight path (down to 30 km and 6 km/sec) for interplanetary re-entry lies well within the MHD control regime. (auth)

10422 MOTION OF ELECTRONS IN MAGNETIC BOTTLE. [PART] V. Tadao Honzawa (Nagoya Univ., Japan). Kakuyugo-Kenkyu, 12: 285-303(Apr. 1964). (In Japanese)

For experimental investigations of the behavior of electrons in a magnetic field of mirror-type geometry, a magnetic bottle was constructed, and electrons of about 1 kev were injected into the bottle from an electron gun. Studies were made on the mechanism of loss of the trapped particles from the bottle. The containment time of these particles was determined from their spatial distribution, which was measured, using a movable detector with a small aperture. Helium or argon gas was used at various pressures, p. From the p- and Z-dependences of the containment time, where Z is the atomic number of gas, it was concluded that the loss of 1-kev electrons is explained in terms of the mirror-loss due to atomic collisions, rather than due to Coulomb scattering. (auth)

10423 THE WIDTH OF SPECTRAL LINES OF ATOMS AND IONS IN A PLASMA. L. P. Kudrin and Yu. A. Tarasov. Opt. Spectry. (USSR) (English Transl.), 17: 265-9 (Oct. 1964). Translated from Optika i Spektroskopiya, 17: 489-98(Oct. 1964).

The method of Green's functions and the diagram technique are used in an exact calculation of the probability of radiationless transitions of atoms and ions in a plasma with correlation of the charged particles taken into account. For the case in which the distance between the atomic levels is small with respect to kT, it was possible to obtain a formula for the collision width in which the expression under the logarithm is exactly determined and depends on the Langmuir frequency ω_0. (auth)

10424 ELECTRON DENSITY AND TEMPERATURE MEASUREMENTS IN A 26 kJ Θ-PINCH BY LIGHT SCATTERING. H. J. Kunze, A. Eberhagen, and E. Fuenfer

(Institut fur Plasmaphysik, G.m.b.H., Garching, Ger.). Phys. Letters, 13: 38-9(Nov. 1, 1964).

Light-scattering measurements in a theta pinch are reported and compared with spectroscopic determinations of electron density and temperature distributions in the same theta pinch and also with theoretical results of the three-fluid theta-pinch model. A hydrogen plasma at an initial pressure of 0.15 torr and an average degree of preionization of ~ 40% was investigated. A ruby laser (5 Mw, 30 nsec) was used as the light source. (C.E.S.)

10425 A VIRIAL THEOREM FOR PLASMAS. J. M. Gandhi, V. P. S. Nain, and B. P. Vinayak (Univ. of Rajasthan, Jaipur, India). Phys. Letters, 14: 27-8(Jan. 1, 1965).

An equation representing the complete statement of the tensor form of the virial theorem for plasma is derived. (C.E.S.)

10426 MEASUREMENT OF THE FARADAY EFFECT IN A Θ-PINCH PLASMA USING A He-Ne LASER. I. S. Falconer, R. Benesch, and S. A. Ramsden (National Research Council, Ottawa). Phys. Letters, 14: 38-40(Jan. 1, 1965).

A measurement of the Faraday rotation in a theta-pinch plasma using a He-Ne laser operating at 6328 Å as the light source is reported. This measurement provides a means for determining the magnetic field within a plasma without perturbing the plasma. (C.E.S.)

10427 EFFECT OF COLLISIONS ON THE MAGNETOCONDUCTIVITY TENSOR OF A QUANTUM PLASMA. Soitiro Tosima, John J. Quinn, and Murray A. Lampert (RCA Labs., Princeton, N. J.). Phys. Rev., 137: A883-8 (Feb. 1, 1965).

The effect on the quantum magnetoconductivity tensor of the scattering of electrons by thermal phonons and lattice imperfections is taken into account by the introduction of a phenomenological relaxation time τ. This is accomplished by introducing into the equation of motion of the single-particle density matrix ρ, a term $\tau^{-1}\{\rho-\rho_0(H_K(t))\}$. $H_K(t)$ is the entire kinetic part of the hamiltonian, including the time-dependent vector potential, and $\rho_0(H_K(t))$ is the equilibrium value of the density matrix appropriate to a system in which the hamiltonian is held fixed for all time at the value which $H_K(t)$ has at time t. It is demonstrated that the results obtained reduce to the known semiclassical conductivity tensor in the appropriate limit. (auth)

10428 DEUTERIUM ARC FLUTE STABILIZATION. R. A. Gibbons and N. H. Lazar (Oak Ridge National Lab., Tenn.). Phys. Rev. Letters, 13: 703-5(Dec. 14, 1964). (ORNL-P-520)

Arc confinement in deuterium in the type of "minimum-B" magnetic field produced by a single coil is studied. Probe studies outside the main arc core indicate the existence of anomalously high transport of plasma across the magnetic field, and the presence of flutelike fluctuations in the plasma density. It is concluded that the flutes are responsible for the anomalous diffusion. (T.F.H.)

10429 COMPARISON OF SOME EXPERIMENTAL RESULTS OBTAINED ON DIFFERENT TYPES OF PLASMA GENERATORS. J. Brossard, M. Denis, and P. Fauchais (Faculté des Sciences, Poitiers, France). Rev. Hautes Temp. Refractaires, 1: 97-106(Apr.-June 1964). (In French)

A summary of the technological features of three plasma generators in which stabilization of the arc is obtained either by considerable vortex movement or by a mainly longitudinal flow of gas feed is given. A micro-generator of very simplified construction is also described. The experimental technique and the various measurements characterizing such generators being defined, some results of observations concerning more particularly stability and thermal efficiency during operation with nitrogen are reported. Study of the effects of the distance between the electrodes and of the gaseous output, has enabled a stable field of operation to be defined. (auth)

10430 STUDY OF LAMINAR PLASMA JETS OF ARGON. F. Cabannes, F. Joubert, and A. Sy (C.N.R.S., Bellevue, France). Rev. Hautes Temp. Refractaires, 1: 107-9 (Apr.-June 1964). (In French)

The jet of a plasma-gun (of continuous current) is laminar under certain conditions of Ar output and electrical intensity. The characteristics of this laminar jet and its temperatures are indicated. (auth)

10431 RESEARCH ON LINEAR CROSSED-FIELD STEADY-FLOW D.C. PLASMA ACCELERATORS AT LANGLEY RESEARCH CENTER, NASA. G. P. Wood, A. F. Carter, A. P. Sabol, D. R. McFarland, and W. R. Weaver (NASA Langley Research Center, Hampton, Va.). p.1-45 of CONF-752(Pt.I)

Results and research with 1-cm-square and small expanding accelerators are described. The solutions to problems incurred with the arc heater and seeding apparatus for a 2.5-cm-square accelerator are given, and operational problems due to large Hall potentials and to erosion are discussed. The theory is improved by deriving the equations that describe the flow without making the assumptions concerning the specific heats that are usually made and that are not valid at high temperatures. Time-of-flight velocity measurements constitute the principal diagnostic method. The 2.5-cm-square accelerator works well and accelerates nitrogen from 2000 to 6000 meters per second with an exit density corresponding to an altitude of 45 kilometers. (auth)

10432 APPLICATION OF DISTRIBUTED CHARGE EXCHANGE TO A CROSSED-FIELD ACCELERATOR. J. L. Wyatt and W. B. Day (Aerojet-General Nucleonics, San Ramon, Calif.). p.47-68 of CONF-752(Pt.I).

The technique of distributed charge exchange is analyzed as an alternative to elastic collisions, for exchanging momentum between a plasma and a neutral gas for the E × B accelerator. In order to develop this concept, a somewhat different approach to the E × B accelerator is used. It is shown that proper adjustment of plasma density, background neutral particle density, and electric and magnetic fields can produce a continuous, high-velocity stream of neutral particles that is useful in many E × B accelerator applications. (auth)

10433 THEORY OF RAREFACTION WAVES IN A PLASMA. G. W. Paxton and R. G. Fowler (Univ. of Oklahoma, Norman). p.69-108 of CONF-752(Pt.I).

A theory for the rarefaction process in a plasma carrying an electric current is developed for the one-dimensional case. General criteria are derived that determine the nature of the rarefaction process as a function of the electron temperature and degree of ionization in the plasma. The analysis shows that under certain conditions the rarefaction wave is a rarefaction shock. The theory is applied to the rarefaction wave in the driver section of the electric shock tube in order to determine the velocity of the compressional shock produced in terms of the electron temperature, degree of ionization, and plasma density in the driver section. (auth)

10434 FUNDAMENTAL STUDIES ON PLASMAS IN A MAGNETOHYDRODYNAMIC (MHD) SHOCK TUBE. R. M. Head, J. Valensi, and Y. Charvet. p.163-245 of CONF-752(Pt.I). (In French)

Experimental tests have been carried out in a MHD shock tube in order to measure the light front velocity and to determine the plasma ion density, temperature, and speed by means of spectrographic analysis. (auth)

10435 MICROWAVE INVESTIGATION OF PLASMOIDS. Emmanuel A. Valsamakis. Thesis, Troy, N. Y. Rensselaer Polytechnic Inst., 1963. 175p.

The plasmoids examined by microwave techniques were generated with a button gun. A waveguide section, called plasma post, was designed to probe the plasmoid. This plasma post was placed around the vacuum chamber where the plasmoid was generated, and was a part of a microwave bridge set up with two outputs. These outputs were calibrated in terms of the positive column of a glow discharge. The electron density, collision frequency, speed, and the extent of the plasmoids were measured at different distances from the source, and the effect of the pressure and source energy on those parameters was observed. The electron density increased close to the source and at increased pressures. At higher source voltages, higher yields were observed in the range of 10^{14} ions. The collision frequency was high near and far away from the source. An increase in the source voltage and background pressure tended to decrease the collision frequency. The plasmoid speed was of the order of 5×10^6 cm/sec, and it increased at higher source voltages and lower pressures. The plasmoid was expanding with time. This expansion was bigger for higher source voltages. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10436 MICROWAVE AND ELECTRON BEAM INTERACTIONS WITH A FINITE PLASMA. Harry Leroy Stover. Thesis, Stanford, Calif., Stanford Univ., 1964. 251p.

The interaction between an electron beam and a finite plasma system is both theoretically and experimentally. In the formal theoretical analysis, the plasma and beam are treated as frequency dependent dielectrics. The equivalent tensor dielectric constant is derived for a region containing a zero temperature stationary plasma and an ion-neutralized electron beam in a d-c magnetic field. Exact solutions to the Maxwell equations are obtained and the exact dispersion relation is obtained for a beam and plasma filling a waveguide. The slow-wave approximation is then introduced and a formal field theory is developed for a general finite beam-plasma system. A propagation and field theory is developed, both analytically and numerically, for the slow waves on a plasma column that has a radial variation in electron density and is in d-c magnetic field. It is predicted that it should be difficult to couple to the $n = 0$ backward-wave modes, and this prediction is borne out experimentally. R-f diagnostic techniques for measuring edge electron densities, average electron densities, and axial electron densities are developed theoretically and explored experimentally. The plasma profile of a d-c discharge plasma in zero magnetic field is determined by r-f measurements, and estimates of the form of the plasma profile in a d-c magnetic field are made. The effects of plasma rotation are studied theoretically and experimentally. A gain theory is developed, both analytically and numerically, for a zero temperature finite beam-plasma system in a finite d-c magnetic field. The gain is predicted to be finite at all frequencies even though the temperature effects are neglected. The physical gain mechanism is found to be different in various frequency ranges. Data obtained from an experimental cesium plasma amplifier tube gave reasonable agreement with theory. The attenuation of the slow waves on a plasma column is investigated both theoretically and experimentally. By utilizing results of the Pavkovich-Kino sheath theory, very good agreement between theory and experiment is obtained and it is found possible to resolve a long-standing anomaly of slow-wave attenuation theory. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10437 ION EFFECTS ON WHISTLER MODE PROPAGATION. Jack Smith. Thesis, Tucson, Ariz., Univ. of Arizona, 1964. 132p.

Equations are developed for the propagation constants of left and right hand circularly polarized waves traveling along the static magnetic field of a magnetoplasma composed of electrons, positive ions, and negative ions. Using parameters appropriate to ionospheric propagation, expressions are developed for the phase and group velocities of the two polarized waves near the ion gyro frequency. Theoretically it is found that for low collision rates the negative ions cause the right hand circularly polarized wave to be evanescent in a particular frequency range. The lower frequency depends on the mass of the ion and the width of the range depends on the density of the ions. It is also found that the right hand circularly polarized wave exhibits a maximum in the group velocity below the ion gyro frequency, and above the ion gyro frequency there is a particular wave frequency which has a minimum dispersion. Experimental observations regarding low-frequency components of whistler signals, low-frequency atmospheric noise spectra, and a nose effect in hydromagnetic emissions are consistent with the postulation of negative ions in the propagation path. An estimate is made of the percentage of negative hydrogen ions required to produce measurable effects in the propagation of the low frequency components of the whistler signal. A new method for determining whistler path location is proposed and the use of ion effects is discussed in determining some characteristics of the upper ionosphere and some features of whistler signal propagation. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10438 A STUDY OF HYDROMAGNETIC WAVE PROPAGATION IN PLASMA. George Raymond Spillman. Thesis, Berkeley, Calif., Univ. of California, 1964. 95p.

An investigation of the excitation of torsional and compressional hydromagnetic waves, and of the dispersion relation of the torsional wave in a cylindrical deuterium plasma is reported. The theory of azimuthally symmetric waves in a cylinder is reviewed and an expression is derived for the relative excitation of the two wave types by a current between concentric electrodes. The wave type propagating in the cylinder at various frequencies is established by simultaneous measurements of the r and θ components of the wave magnetic field, and the dispersion relation of the torsional wave is measured in the frequency range 0.04 to 0.48 times ion-cyclotron frequency. (The upper frequency limit is due to domination of the compressional wave at higher frequencies.) The measured wave velocity agrees with theoretical calculations of the velocity based on the average of the spectroscopically measured ion density. Scatter in attenuation measurements is too large to give good agreement with the theoretical attenuation; however, the proper general trend is observed. Observations of a plasma surface wave are reported in an appendix. (Dissertation Abstr., 25: No. 3, Sept. 1964)

10439 STATISTICHESKAYA TEORIYA NERAVNOVESNYKH PROTSESSOV V PLAZME. (Statistical Theory of Non-Equilibrium Processes in Plasma). Yu. L. Klimontovich. Moscow, Izdatel'stvo Moskovskogo Universiteta, 1964. 284p.

A system of equations for random N_a, $\vec{E}^M$, and $\vec{H}^M$ functions was used for describing the microscopic state of plasma. The problem of nonequilibrium plasma processes reduced in order to determine random moments for N_a, $\vec{E}^M$, and $\vec{H}^M$ functions. Maxwell equations for slow and fast processes are treated with regard for medium dispersion. The microscopic equations for plasma and averaging of these equations are considered. The system of equations with a self-congruent field and the statistical character of spatially homogeneous and quasihomogeneous plasma are discussed. Plasma wave emission is described by kinetic equations, and expressions for spectral functions are considered. Hydrodynamic processes in plasma are described. (R.V.J.)

10440 ELECTRON TEMPERATURES IN FLAME PLASMAS. M. C. Attard (Oxford Univ.). 7p. (CONF-640701-71)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Measurements were made of electron temperatures in coal-gas fired Bunsen and torch flames at atmospheric pressure. Results indicate that the Bunsen flame is at or near thermodynamic equilibrium whereas the torch flame is in a steady state far from equilibrium and its electron gas is superheated resulting in an electron concentration several orders above that predicted by thermodynamics. (J.R.D.)

10441 ELECTRON CONCENTRATION AND ELECTRICAL CONDUCTIVITY OF SEEDED COAL COMBUSTION PLASMAS. Hans Bincer (Babcock and Wilcox Ltd., Renfrew, Renfrewshire, Scotland). 12p. (CONF-640701-72)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Methods and data used in the calculation of electron concentration and conductivity were applied to an assumed gas resulting from coal–air combustion. Computer calculations were made at 2400, 2600, 2800, 3000, and 3200°K and gas pressures of 1, 4, 7, and 10 atm. Results indicate that the relative quantity of combustion air and its composition have little effect on conductivity. Results of investigations concerning electron affinity to Cl and the hydroxyl radical and the effects of K on conductivity are included. (J.R.D.)

10442 ON PLASMA THROUGH NEUTRON IRRADIATION. J. Braun, K. Nygaard, and E. Witalis (Aktiebolaget Atomenergi, Nyköping, Sweden). 12p. (CONF-640701-66)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

The feasibility of obtaining neutron-induced He plasmas with satisfactory carrier density and lifetime is investigated. (J.R.D.)

10443 A TECHNIQUE FOR THE EVALUATION OF SURFACE ABSORPTIVITY OF MATERIALS EXPOSED TO PLASMA RADIATION. F. C. Hooper (Univ. of Toronto), J. L. Loth, and C. H. Miller. 12p. (CONF-640701-83)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

A macroscopic method for estimating bounding surface absorptivities is described that appears to have distinct advantages over methods which depend upon integrating microscopic phenomena over real regions. The approach circumvents the fourth power radiation relationships through which even small errors in plasma temperature measurement can give rise to results in error by more than an order of magnitude. The principal source of uncertainty in the transducer method arises in the designation of a value for x. The total error from all sources, however, is very unlikely to exceed 25%, representing a degree of reliability for engineering use much higher than could be expected from microscopic interpretations. (auth)

10444 NON-EQUILIBRIUM PROCESSES IN REACTING PLASMA FLOW ACROSS A MAGNETIC FIELD. H. E. Wilhelm and R. T. Schneider (General Motors Corp., Indianapolis). 8p. (CONF-640701-99)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

The establishment of intercomponent nonequilibrium during the expansion of plasma into regions with exterior field forces is investigated. The theoretical model used involves slightly ionized plasma flowing into a channel with a transverse magnetic force field, in which the induced currents are closed by exterior load circuits. (J.R.D.)

10445 MEASUREMENT OF PLASMA ELECTRON TEMPERATURE BY AN EXTERNAL LANGMUIR-TYPE PROBE. R. A. Chapman (Texas Instruments Inc., Dallas). 8p. (CONF-640701-96)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Use of external Langmuir probes to study the temperature of the electron distribution incident on the collector electrode of a diode with Cs pressure up to 4×10^{-3} torr without gas flow or magnetic field is described. High electron temperatures (up to 5000°K) were observed only in those cases for which a visible discharge was observed in the emitter-collector interspace. The electron temperature increased rapidly with increasing total current in the discharge mode. Experiments in the higher and more practical pressure range of total pressure in the flow channel were not performed. It is suggested that the same external Langmuir probe technique could be utilized if a pump were used to lower the pressure in the collector-probe interspace. It is estimated that satisfactory results could be obtained on a Ar–Cs plasma using a pump to reduce the Cs and Ar partial pressures to 4×10^{-1} torr respectively. (auth)

10446 LAMINAR BOUNDARY LAYERS OF CYLINDRICAL BODIES IN MHD. W. Fucks and E. Fisher (Technische Universität, Aachen). 10p. (CONF-640701-105)

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

Methods for calculation of viscous flow past cylindrical bodies are described. The calculations are based on Maxwell's equations, Ohm's law, and the equations of motion and mass conservation. Parameters of the ideal flow are discussed and solutions for boundary layer, flow separation and shear stress, and induced magnetic fields are presented. (J.R.D.)

10447 EXPERIMENTS ON PRESSURE WAVE PROPAGATION IN LOW DENSITY PLASMAS. G. Fonda-Bonardi and J. A. Thronton (Litton Systems, Inc., Beverly Hills, Calif.). 10p. (CONF-640701-29).

From International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris.

An approach to the conversion of thermal energy to electrical energy using the motion of gas contained in a static envelope is described. Electrical power can be obtained as a-c or as d-c. The possibility of obtaining a-c directly from the converter makes this approach attractive for applications where many different voltages are required, since a-c lends itself readily to voltage transformation. Seeding materials added to the gas for improving the conductivity may be conserved using this system. Theoretical considerations and experimental results are included. (auth)

10448 PROGRESS IN FUSION RESEARCH. Herbert C. Pollock (General Electric Research Lab., Schenectady, N. Y.). 18p. (CONF-637-9)

From Institute of Electrical and Electronics Engineers Region 3 Annual Meeting and Technical Conference, Clearwater, Fla., May 1964.

A brief review is presented of the four most promising fusion reactions and the heating and containment problems associated with fusion research. The design and operating characteristics of a small theta-pinch device in use at the G-E Research Laboratory are examined and the high temperature plasma measurements are summarized. It is concluded that there is much uncertainty as to whether any of the present machines can achieve the efficient release of nuclear energy or if fusion power can compete economically with fission power even if brought to a like stage of engineering design. (H.D.R.)

10449 EIGHT-INCH BORE SUPERCONDUCTING COILS. D. N. Cornish and J. E. C. Williams. 9p. (CONF-554-13)

From Cryogenic Engineering Conference, Philadelphia, Aug. 1964.

The construction of a magnetic mirror coil system of a size suitable for a plasma physics experiment is described. The winding and testing of a number of sections of the coil are considered. (H.D.R.)

Shielding

Refer also to abstract 9886.

10450 (AD-443549) BLOCKHOUSE DOSAGE CONTRIBUTIONS RESULTING FROM WINDOW-COLLIMATED, CEILING SCATTERED FALLOUT RADIATION (thesis). James Andrew Baran (Kansas State Univ., Manhattan. Engineering Experiment Station). 1963. Contract OCD-OS-63-74. 163p.

Kansas State Univ. Eng. Expt. St., Spec. Report No. 32.

The theory of the penetration of fallout gamma radiation into structures has been extensively studied and formulated in the past few years. This monograph considers one aspect of this theory which has not been investigated—the contribution of radiation dose rate in a protective structure resulting from fallout radiation entering the structure through apertures in vertical walls and reflecting off the ceiling of the structure. This problem is known as the "ceiling shine" problem. FORTRAN II digital computer programs are written whereby the differential and total (incident and reflected) aperture-collimated, dose rate contributions at the ceiling of an idealized concrete structure are determined. A program was also written for the aperture-collimated, ceiling-scattered dose rate at any point in the structure. Results are graphically presented for the case of a concrete blockhouse (a 20 ft × 20 ft × 8 ft structure with basement and a window centered horizontally in one wall). This window covers approximately 5% of the area of one wall. The average total dose rate albedo of the concrete blockhouse ceiling for incident cobalt-60 gamma photons was determined from the derived differential dose rate albedo to be fourteen per cent. The window-collimated radiation incident on the ceiling was just under one per cent of the dose rate outside the structure at the standard position three feet above the contaminated plane. Approximately one tenth of one per cent of this outside radiation was thus reflected at a given ceiling point. The total dose rate from this window-collimated, ceiling-scattered radiation was determined for two traverses along the blockhouse centerlines for the detector positioned three feet above the first floor and three feet above the basement floor. These window-collimated, ceiling scattered dose rates were compared with the experimental total dose rates received by the detector in the blockhouse surrounded by an infinite plane field of cobalt-60 contamination. The window-collimated, ceiling-scattered dose rates for the above described blockhouse with a five per cent aperture in each of the four walls were approximately one per cent of the total on the first floor and about two per cent of the total in the basement. When the window was increased in size to cover sixty per cent of the wall area with its lower edge higher above the ground than the detector position, the window-collimated, ceiling-scattered radiation was about twelve per cent of the total on the first floor and about twenty-six per cent of the total in the basement. (auth)

10451 (AD-609049) AN EMPIRICAL FORMULA FOR CALCULATING GAMMA-RAY DOSE ATTENUATION IN CONCRETE DUCTS. W. C. Ingold and C. M. Huddleston (Naval Civil Engineering Lab., Port Hueneme, Calif.). Nov. 25, 1964. 72p. (R-349). $2.00(OTS).

A survey is presented of the status of the calculation of gamma dose-rate attenuation in air ducts through concrete. A simple empirical formula is exhibited that shows satisfactory agreement with the results of more complicated computational techniques and with experimental results. This simple formula, which may be used for hand computation, represents a saving in computation time −2 seconds per case compared to 400 seconds by IBM-1620. (auth)

10452 (CERN-64-47) MONTE CARLO CALCULATION OF THE NUCLEON-MESON CASCADE IN SHIELDING MATERIALS INITIATED BY INCOMING PROTON BEAMS WITH ENERGIES BETWEEN 10 AND 1000 Gev. J. Ranft (European Organization for Nuclear Research, Geneva). Nov. 18, 1964. 68p. Dep.(mn).

Monte Carlo calculations of the nucleon-meson cascades in shielding materials are carried out, for primary proton energies of 10 to 1000 Bev. The calculations are carried out first for iron shielding, and the results compare well with experimental observations. The calculations are adapted to concrete, and the predictions are found to agree with measurements in this medium as well. (T.F.H.)

10453 (EUR-2152.e) MAC-RAD—A REACTOR SHIELDING CODE. U. Canali, C. Ponti (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy); H. Ilsemann, and H. Preusch (Allgemeine Elektrizitätsgesellschaft, Frankfurt am Main). 1964. 165p. Dep.(mn)

MAC-RAD is a Revised And Developed edition of the Multigroup Attenuation Code MAC. This program gives, for slab geometries, the following informations as a function of distance from the core boundary: Multigroup neutron fluxes; neutron dose rates; approximate neutron spectrum; gamma fluxes for seven energy groups; gamma dose rates; and approximate gamma spectra. The assembly may contain up to 20 compositions, the first two being in the core. The maximum number of neutron groups is 35. The gamma groups number is 7. The following sources of radiation may be considered: in the core, fission neutrons, prompt gamma rays, and gamma radiation emitted by fission products in steady state; and in the whole assembly, neutron capture gamma rays. The neutron flux at a point P of the shield results from two contributions: the flux of the uncollided neutrons which reach P without interactions (calculated by means of the first collision method), and the flux of the neutrons which reach P after having been scattered by the nuclei of the medium. These are computed by means of the diffusion theory. Both elastic and inelastic scattering are considered. The gamma flux is computed by the first collision method, considering average build-up factors for all shielding materials. (auth)

10454 (P-157(RAND)) SCATTERING AND ABSORPTION OF GAMMA RAYS. M. S. Plesset (California Inst. of Tech., Pasadena) and S. T. Cohen (RAND Corp., Santa Monica, Calif.). June 1, 1950. 42p. (AD-603883). $2.00 (OTS).

A formulation is presented of the scattering and absorption of gamma rays in different materials. The range of gamma ray energies considered is from 1 to 10 mc^2. Results are given for the transmission of gamma rays through air and lead. (auth)

10455 RADIATION SHIELDING CONSIDERATIONS IN MANNED SPACECRAFT DESIGN. Sidney L. Russak (Martin Co., Baltimore). J. Spacecraft Rockets, 1: 310-16(May-June 1964).

A procedural analysis that minimizes the space radiation hazard is described for all engineering phases up to hardware design and illustrated by its application in recent studies. Radiation dosages are shown to differ significantly among different spacecraft configurations for the same mission. Estimated radiation dosage levels also vary significantly, depending on the degree of detail to which the spacecraft and body models are designed. In view of the important mission-configuration-dosage relations that were found and the detailed body-radiation tolerances now specified, an efficient treatment of the radiation hazards to manned spaceflight must begin during preliminary design. Detailed inputs must come from system design groups early enough to allow the radiation analysis results to be used in the final determinations of external configuration, materials, and inboard profile. (auth)

10456 BACKSCATTERING OF GAMMA RAYS FROM POINT SOURCES BY AN INFINITE-PLANE CONCRETE SURFACE. A. B. Chilton (Univ. of Illinois, Urbana). Nucl. Sci. Eng., 21: 194-200(Feb. 1965).

Backscattering factors, as fractions of the direct dose rate, are obtained for point sources of gamma radiation, specifically ^{137}Cs and ^{60}Co, placed near a plane interface between vacuum and concrete. The method is based on the application of albedo principles, using the Chilton-Huddleston formulation for albedo. The results are considered practically applicable to air-concrete or air-ground interface situations, provided the source-detector, source-interface, and detector-interface distances are within certain limits. The lower limit is in theory the order of a mean free path of the source radiation in concrete, although under certain circumstances the results are valid for distances even less. The upper limit appears to be on the order of a few dozen feet, but further precise experimental work is needed to establish this. (auth)

10457 THE INTENSITY AND SPECTRAL DISTRIBUTION OF SCATTERED RADIATION FROM COBALT-60 SOURCES. B. Petree and J. C. Humphreys (National Bureau of Standards, Washington, D. C.). Radiology, 84: 129-30(Jan. 1965).

Approximate computations were made to allow for differences between model and actual ^{60}Co sources, and an appreciable intensity of multiply scattered photons was found. To obtain values for the energy of the multiply scattered component, two spherical chambers were constructed of Al and Cu. Comparison of the relative sensitivity of the Al chamber with a graphite chamber only below about 200 kev showed an appreciable intensity of photons below 200 kev energy. The measured current ratio of Cu and C chambers was used to determine the proper energy to be assigned to the multiply scattered component. This energy was found to be 105 kev, which is near the peak of response of the Cu chamber. With the use of the spectrum thus determined, the computed current ratio of the Al and graphite chambers was within 0.3% of the measured ratio. This close agreement was taken to indicate that representation of the spectrum is adequate for accurate absorbed dose computations in materials of atomic number as high as 29. (P.C.H.)

10458 IMPROVEMENTS IN OR RELATING TO CONDUIT MEANS. (to Gesellschaft fur Linde's Eismaschinen AG). British Patent 973,529. Oct. 28, 1964. Priority date Jan. 4, 1962, Germany.

A conduit means comprising a pipe extending from a radiation-containment space to a radiation-free space through a radiation-absorbing wall is described. A part of the pipe is loosely filled with nuclear radiation-absorbing elements in order to reduce the transmission of radiation from radiation-contaminated space to radiation-free space. The density to which the part of the pipe is filled with the radiation-absorbing elements is determined by the size and shape of the elements. The arrangement should be such that no straight paths are available in the filled part of the pipe but gas flow through the pipe is not hindered unacceptably. Six embodiments of the invention are described in detail. (A.G.W.)

REACTOR TECHNOLOGY

General

Refer also to abstracts 10453 and 10677.

10459 (EURAEC-1164) THE STEADY STATE AND DYNAMIC BEHAVIOUR OF A BOILING WATER REACTOR. Quarterly Progress Report XIV, April 1–July 1, 1964. (Eindhoven, Netherlands. Technische Hogeschool). Work Performed under United States–Euratom Joint Research and Development Program. Contract P-313. 19p. (WWO16-R71) Dep.(mn); $1.00(cy), 1(mn) OTS.

A new atmospheric boiling glass loop has been built incorporating a subcooler. The influence of subcooling on the hydraulic instabilities could be made visible. The automatic data logger has been delivered to the laboratory. This instrument converts analog into digital data with a conversion speed of 3000 samples per second. A puncher has been added capable to punch 120 characters per second. The data logger is under test. The experiments using a seven-rod bundle heating element have been finished and will be reported separately. Experiments have been carried out both with and without hot patches. At higher pressure, burnout occurred in stable noisy conditions, while at low pressure severe hydraulic oscillations of about 1 cps were present. Preliminary experiments were carried out on a single rod annular test section with ID of the shroud of about 60 mm. In these experiments a strange loop behavior has been observed. By increasing the power from 45 to 50 kw at 120°C saturation pressure, the remote level gage shows a large change in water level. By increasing the power further, the water level restores again gradually. Downcomer entrainment as possible cause is looked into. The computer program which calculates the transfer functions from digitized noisy signals from the loop has been tested. Comparison with theoretically derived transfer functions shows good agreement. The computer program of the theoretical description by Jahnberg has been finished and tested. Another system for the solution of these equations has been used, namely the method of characteristics, which seems more straight forward than the procedure described in the original publication. The testing of the equations based on first principles and including the diffusion of the two phases in a steam–water mixture is well under way. It became evident that some mechanism for coalescence of bubbles had to be incorporated into the model. (auth)

10460 (NAA-SR-Memo-10512) COLUMBIA UNIVERSITY BOILING WATER HEAT TRANSFER EXPERIMENTS WITH TWELVE-ROD TEST SECTIONS. Status Report. T. J. Sadowski (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 29, 1964. Contract [AT(11-1)-Gen-8]. 21p. Dep.(mn); $1.00 (cy), 1(mn) OTS.

Tests are conducted to aid in the evaluation of the thermal hydraulic characteristics of the COMPACT reactor core. The core geometry was simulated in a high-pressure, boiling-water loop by an electrically heated 12-rod bundle in vertical upflow at 1200 psia. The influences of mass velocity, mean exit quality, power distribution, and wall-to-rod separation on the burnout heat flux were obtained from five different test sections. A significant aspect of the program was the analysis of the data by means of a multi-channel, two-phase hydraulic code. Such analyses have shown that geometry has a crucial influence on the burnout heat fluxes obtainable from multi-rod test sections. These and other aspects of the experiments are summarized and discussed. (auth)

10461 (TDVI-33) THE DISCHARGE OF HIGH ENTHALPY WATER FROM PIPES UNDER THERMAL GRADIENTS. R. I. Hawes (Atomic Energy of Canada Ltd. Nuclear Power Plant Div., Toronto). Aug. 1961, Revised and Reissued May 1964. 25p. (AECL-1933). $1.00 (AECL).

The experiments reported were intended to examine the discharge of water under the conditions which would exist if a split occurred in a "cold" reactor header. This is considered to represent a worse case than a complete rupture of this header, although further tests are required in order to establish this. The peak discharge rate and the mean discharge rate over the first one second of the process is seen to be markedly dependent upon the geometry of the opening. As with flow of a single phase fluid, the discharge rate through a rounded nozzle is greater than that through a sharp edge nozzle. (auth)

10462 (TID-8200(11th Rev.)) NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF DECEMBER 31, 1964. Harvey I. Mueller, comp. (Division of Reactor Development, AEC). 32p. Dep. $1.00(OTS).

A compilation is presented of information on power, testing, research, safety-experiment, and teaching reactors and critical facilities in the U. S. as of 31 Dec. 1964. The information is categorized by primary function or purpose of the reactor or facility. (T.F.H.)

10463 SURVEY ON WORLD REACTORS AND THEIR FUEL ELEMENTS. Tsutomu Kawamura. Nippon Kogyo Kaishi, 79: 622-38(1963). (In Japanese)

World reactors and their fuel elements were surveyed from the point of view of technical and economical aspects. (auth)

10464 NUCLEAR INSTALLATION LICENSING PROCEDURES. M. Hebert. Rev. Protect. Civile Ind., No. 118, 29-34(Apr. 1964). (In French)

A study is presented of the Decree No. 63-1228 of December 11, 1963, relative to the licensing of nuclear installations in France. The procedure instituted by the Decree in the general case is outlined. The composition and duties of the Commission Interministerielle des Installations Nucleaires de Base are reviewed. The obligations imposed on the licensee, and the controls and sanctions under the law are summarized. The complete text of the Decree is included. (J.S.R.)

10465 REACTORS, UK. (United Kingdom Atomic Energy Authority, London). [1964]. 92p.

An index is presented of British research, advanced, Magnox, and university research reactors. The Dragon reactor is also presented in a special category. The index gives the general aspects, operating histories, and nuclear and engineering characteristics of the reactors listed. (T.F.H.)

10466 CALCULATION OF THERMAL STRESSES IN NUCLEAR REACTORS. Iosif Izrailevich Gol'denblat and Nikolai Aleksandrovich Nikolaenko. Translation of Raschety Temperaturnykh Napryazhenii v Yadernykh Reaktorakh. New York, Consultants Bureau, 1964. 82p.

Thermoelastic and thermoplastic stresses in fuel elements, thermal stresses in a medium containing voids, thermal shock in the structural elements of a reactor, design of various structural elements for thermal creep, stabilized creep of nonuniformly heated cylindrical and spherical metal shells, thermal stresses and creep in thick-walled concrete and reinforced concrete shells are discussed. The nonlinear theory of thermal stresses in plates and shells is considered. (M.C.G.)

Auxiliaries and Components

10467 (GEMP-85) REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT NO. 85. (General Electric Co. Advanced Technology Services, Cincinnati). Nov. 30, 1964. Contract AT(40-1)-2847. 21p. Dep.; $1.00(cy), 1(mn) OTS.

Refinement of the 1600°C integrated capacitance temperature probe and readout system using single-crystal sapphire is reported along with several preliminary tests to determine the response time of the single-crystal alumina capacitance temperature sensor with that of a thermocouple. A single-lead, uncompensated a-c ionization chamber suitable for operation up to 500°C was designed and built. Some modifications were made on the 60-cps control system components. A technique for reducing the apparent d-c leakage current of an ionization chamber was investigated. Investigations of charged-fragment neutron sensor design and the use of magnetic fields to control low-energy secondary electrons in order to improve sensor performance were continued. (N.W.R.)

10468 (NAA-SR-8119) STUDY OF SCTI CONTROL SYSTEM. C. W. Griffin, ed. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1, 1964. Contract AT-11-1-GEN-8. 269p. Dep.; $2.00(OTS).

The Sodium Components Test Installation (SCTI) is a 35-Mw design capacity fossil-fired test installation with a primary and secondary system; a sodium-heated steam generator; a pressure-reducing system desuperheater, to simulate the turbine; a condenser; and a feedwater cooling system. Stability studies of the control systems associated with this complex were performed on analog equipment. The greatest difficulty was encountered in attempting to describe the IHX (intermediate heat exchanger) and once-through steam generator in simple mathematical terms, especially since very little could be found in the literature on once-through steam generators. It was discovered that a single-node representation of the IHX was ample for purposes of obtaining controller settings and stability determinations. However, a 3-node simplified model of the steam generator proved inadequate in studying low-flow conditions. The complexity of the problems required that the control system be divided into two main sections for analog study, so as to limit the number of analog machines to no more than three in any one setup. The two sections were: the primary system and IHX; and the secondary system, steam generator, and feedwater-steam control complex. Other areas were analyzed by use of Bode plots. The individual systems were found to be stable, and controller settings were obtained. In view of the low-flow inadequacy of the model for the once-through steam generator, a somewhat more complex mathematical model was developed. (auth)

10469 (NASA-CR-54204) PNEUMATIC NUTATOR ACTUATOR MOTOR. First Quarterly Report. C. N. High, G. R. Howland, and J. R. Williamson (Bendix Corp. Bendix Products Aerospace Div., South Bend, Ind.). Sept. 30, 1964. Contract NAS3-5214. 57p. (BPAD-864-15521R)

A twelve-month program is being conducted to design, fabricate, and test a prototype pneumatic nutator actuator motor for drum control of a nuclear reactor. The high-torque, low-speed motor contains an integral transmission consisting of a pair of bevel gears, one of which is operated in a nutation motion by a number of pressurized bellows located around its periphery. Pneumatic flow is commutated to the power bellows by means of a number of vortex type fluid interaction devices. Both mechanical and fluid state element designs were established. Tests were performed on components of the commutation circuit, the results of which are described. Based upon these tests, the dimensions of the power and selector vortex valves which form a major portion of the commutation circuiting were established. Fabrication status of all components is described. (auth)

10470 (ORNL-3747) STRESS-STRAIN MEASURING SYSTEM FOR IN-REACTOR USE IN HIGH NEUTRON FLUX. W. W. Davis and C. R. Kennedy (Oak Ridge National Lab., Tenn.). Jan. 1965. Contract W-7405-eng-26. 8p. Dep.; $1.00(OTS).

A system is described for creep testing graphite specimens under an irradiation flux field of 2×10^{13} neutrons cm^{-2} sec^{-1} ($E > 1$ Mev) in a poolside facility of the Oak Ridge Research Reactor. Differential pressure across stainless steel bellows is used to load parabolic cantilever-beam creep specimens. A linear resistor as a potentiometer in a null balance circuit continuously measures the strain as the deflection of the parabolic specimens. The resulting overall sensitivity of the strain measurement was about 10^{-6}. This system has demonstrated its ability to endure the irradiation environment, and it can be modified easily for testing of a variety of materials. (auth)

10471 "INTEGRATED" FUEL HANDLING IN GAS-COOLED REACTORS. Hartwig Benzler. Euratom Bull., 3: No. 4, 17-25(Dec. 1964).

A reactor fuel-element handling device, located entirely within the prestressed concrete pressure vessel which also contains the reactor core, is described. Schematic diagrams illustrating the operation of the device are given. Advantages of the integrated handling device and some problems — changes from previous methods of breakdown servicing, reactor control, guiding and supervising handling operations, and designing of lock chambers against pressurized gas — are discussed. Testing and development studies on a full-scale model, on performance in CO_2 atmosphere, on lock-chamber design, on control devices and motors, and on automation of the model are described. (M.J.T)

10472 CHANNEL HYDRAULICS MEASUREMENTS USING AN IN-LINE ANALOGUE COMPUTER. J. Hannaford and G. Kjaerheim. Euro Nucl., 1: 206-11(Dec. 1964).

HBWR studies on the hydraulics of a natural-circulation, boiling channel were performed over a wide power range and involved investigations of a number of influencing parameters. The main tools were the instrumented fuel assemblies, which provided the raw data, and an in-line general-purpose analog computer, which processed the data and facilitated immediate print-out of results. The experimental techniques and instrumentation are described, and typical results from the different experiments and summary results from the parametric studies are presented. (auth)

10473 THE AUTOMATICAL DRIVING OF THE REFUELING MACHINE. Jaroslav Havel and Mironslav Kondr. Jaderna Energie, 10: 392-4(1964). (In Czech.)

A refueling machine is described, which can align a selected refueling standpipe automatically within ±0.5 mm, from a 60-m remote operating room. The functions are described. The refueling machine is positioned at a spot over the selected reactor refueling standpipe even if the coordinates of the center line of the standpipe differ from their ideal position, which can be caused by temperature effects, manufacturing deviations, etc. The advantages of the equipment are the relative simplicity, the possibility of continual operation, and accuracy of positioning control. Good operating characteristics of the equipment were obtained, using a transmitter bridge combined with an optical system, based on photoelectric semiconductor changers and on an industrial television set. (auth)

10474 USE OF A COMPUTER FOR MONITORING THE TEMPERATURES IN A NUCLEAR REACTOR. J. Leclerc. Tech. Mod., 56: No. 4, 51-3(Apr. 1964).

A digital data processing unit for the critical core layout of the Cesar reactor using a Pb 250 computer is described. This equipment provides 180 temperature measurements with accuracy, prints them according to a symbolic geographical display (map form), compares them with ceiling values, corrects them according to pre-set calibration of the detectors (thermocouples) and lastly performs simultaneous scientific calculations on the scanning and printing of all 180 channels. (auth)

10475 IMPROVEMENTS RELATING TO AUTOMATIC COOLING GAS CONTROL VALVES FOR GAS-COOLED NUCLEAR REACTORS. Frank Hollins Buckley (to Fairey Engineering Ltd.). British Patent 972,474. Oct. 14, 1964. Filed Mar. 5, 1962.

A valve to automatically control the flow of cooling gas through the fuel channels and into the charging chute as fuel elements are successively removed from a reactor is described. The valve is made up of several temperature-sensitive bimetallic members subjected to the gas flow through the chutes during the recharging operation of the reactor. The valve is fully open during operation at normal working temperature of the gas flow from a fully loaded fuel channel through the chute and closes as the gas temperature falls with the removal of each successive fuel element from the fuel channel. (A.G.W.)

10476 PNEUMATIC TRANSPORT TUBE CONTAINER FOR USE IN A NUCLEAR REACTOR. (to European Atomic Energy Community (Euratom)). British Patent 972,798. Oct. 14, 1964. Priority date Sept. 13, [1962], Germany.

The sample carrier or rabbit described is designed to reduce the time required to remove the sample and prepare it for measurement. The container, for use in a pneumatic tube transporting samples into and out of a reactor, is provided with a weighted element freely mounted in the container behind the sample material. The element is adapted, directly or indirectly, to open a frontal closure and instantly expel the sample material when the container strikes against an abutment member at the receiving station. The weighted element is preferably formed as a piston or piston-ram assembly mechanically connected to a punch mounted ahead of the sample for breaking the closure. Modifications of the container permit its use with solid, liquid, or gaseous samples. (A.G.W.)

10477 DEVICE FOR THE FIXATION OF NUCLEAR FUEL ELEMENTS IN THE CHANNEL OF A CORE. Noel Laurent and Alphonse Peuchmaur (to Commissariat à l'Énergie Atomique). German Patent 1,175,803. Aug. 13, 1964. [Priority date June 6, 1961, France].

A locking device is described, which comprises a rigid, fixed annular member provided with tongues displaced circumferentially within the channel. These tongues are in engagement with the end of the inserted fuel element. They are arranged in such a way that they are relieved of axial directed forces, e.g. the weight of the fuel element or the pressure of the cooling medium. (Gmelin Inst.)

Criticality Studies

Refer also to abstract 10507.

10478 (CEA-R-2489) ETUDE DES RESEAUX A L'EAU LEGERE PAR LA METHODE D'EMPOISONNEMENT HOMOGENE AU BORE. (Studies of Light Water Lattices by the Boron Homogeneous Poisoning Technique). Jean Bailly, Jean Calament, Yves Girard, and Claude Golinelli (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Aug. 1964. 24p. Dep.(mn)

By homogeneously poisoning a critical facility with boric acid, one can balance important reactivities. This technique is particularly interesting because it allows the substitution of cross sections to kinetic parameters in lattice calculations. With this use of boric acid as a poison arise important technological problems, which are described. The accuracy of the method is also investigated. The main features of a lattice study made according to this moderator poisoning technique concern the determination of the concentration of dissolved boron which makes the multiplying assembly just critical and the determination of the reactivity factor as a function of temperature (this study has been carried out above 95°C). (auth)

10479 (CEA-R-2550) PROGRAMME DE CALCUL DES TRANSITOIRES ACCIDENTELS DES PILES DE LA FILIERE GRAPHITE–GAZ. (Calculation Program for the Accidental Transients in Reactors of the Gas–Graphite Type). Christian Henri and Jean-Paul Bayard (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). 1964. 38p. Dep.(mn)

The study of the behavior of the fuel during certain incidents or accidents in reactors is closely connected to the study of the changes in temperature. The main physical phenomena governing the kinetics of the accident are described. The aim is to know the temperatures at all points and at all times during the irregular regime which can follow the initial stable regime. An explanation is given of the numerical methods used. (auth)

10480 (CRRP-1185) THE EFFECT OF NEW DATA ON REACTOR POISONING BY NON-SATURATING FISSION PRODUCTS. W. H. Walker (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1964. 32p. (AECL-2111). Dep.; $1.00(AECL).

An Addendum to CRRP-913 and CRRP-1090.

New pseudo-fission product yields have been calculated for thermal-neutron fission of U-233, U-235, Pu-239, and Pu-241, and fast-neutron fission of U-238, based on new input cross section and fission yield data. The input values were obtained from a review of published yields and cross sections, including data published since 1960. The effect on reactor poisoning of three β-active nuclides with relatively short half-lives are demonstrated. In the case where these are secondary to a non-saturating primary fission product (Pm-148 and Pm-148m) a simplified decay scheme has been used to include their contribution in the pseudo-fission product calculations. (auth)

10481 (EUR-2103.e) COSTANZA—A NUMERICAL CODE FOR THE STUDY OF THE REACTOR SPATIAL DYNAMICS IN TWO GROUPS. E. Vincenti, R. Monterosso (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy); A. Agazzi (Gavazzi (C.) S.P.A., Milan). 1964. 52p. Dep.(mn).

A numerical code is described for the IBM 7090, concerning the dynamics of a power excursion reactor (TESI). The reactor, of cylindrical form, is considered as a horizontal infinite slab with upper and lower reflectors. The spatio-temporal diffusion equations of the two-groups approximation are transformed into a system of linear equations, by means of the finite-difference method. The temperature feedback effect on reactivity is calculated at every point considering that during the transient the reactor is not cooled. The code consists of two sections. The first section calculates the uniformly distributed poison (control rods completely withdrawn) which makes the reactor overcritical with a required stable period and determines the position of the control rods and the flux distribution at criticality for a cold reactor. The second section simulates the movement of the control rods and calculates the evolution of flux and temperature in space and time during the power excursion. Some numerical cases are given and compared with results calculated with the analog computer and with AIREX and PINETO codes. (auth)

10482 (EUR-2104.e) THE CODE COSTANZA. A. Agazzi (Gavazzi (C.) S.P.A., Milan), E. Vincenti, and R. Monterosso (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 68p. Dep.(mn).

Use of the code COSTANZA I is explained. This code studies the spatio-temporal dynamics of a reactor, in the two-group approximation and in one space dimension. (auth)

10483 (GEAP-4630) THE EFFECTS OF RESONANCE OVERLAP ON THE DOPPLER COEFFICIENT IN A FAST CERAMIC REACTOR. COMPUTER CODES RAVE AND DOPIE. B. A. Hutchins (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Aug. 1964. Contract AT(04-3)-189. 104p. Dep.(mn); $4.00(cy), 2(mn) OTS.

Two effects in the calculation of the Doppler coefficient in a fast ceramic reactor were evaluated. These are: overlap of resonances of unlike fuel isotopes such as U-238 and the plutonium isotopes; and the temperature dependence of the average flux over an energy interval containing resonances. For the fissile isotopes, these two effects approximately cancel; hence, the old methods of calculation may continue to be used for fissile uranium and plutonium. For U-238 the overlap effect is negligible and, taking into account the temperature dependence of the average flux, produces a small increase of the negative Doppler effect. Two computer codes, RAVE and DOPIE, were developed for this study. The input, computational approach, and equations are described for each. (auth)

10484 (GEAP-4730) PLUTONIUM SUBCRITICAL EXPERIMENT PROGRAM. Program Summary and First Quarterly Report, July 1–September 30, 1964. J. G. Carver (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Oct. 15, 1964. Work Performed under

United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 23p. (EURAEC-1234) Dep.(mn); $2.00(cy), 1(mn) OTS.

The lattice fuel composition and dimensions were selected to provide ready correlation with a large volume of existing criticality data. Existing techniques for producing mixed-oxide fuels were examined thoroughly to establish the degree of homogeneity possible with each method. Nuclear analysis is in progress for a variety of lattices constructed from these rods. Plans and foil specifications are complete for measurement of fission and conversion rates. Preliminary design is complete for the pressurized water system; both heating and pressure control will be accomplished outside the main pressure vessel. A critical path network was set up on the computer to facilitate the maintenance of up-to-date schedule information. (auth)

10485 (HW-72740) THE TIME-DEPENDENT DIFFUSION EQUATION AND SPATIAL NEUTRON KINETICS. C. W. Allen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 20, 1961. Contract AT(45-1)-1350. 13p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The space- and time-dependent neutron diffusion equations and models are formulated for use in reactor kinetics studies. The implications, assumptions, and limitations of these models are investigated. (T.F.H.)

10486 (LA-3148-MS) TEMPERATURE-DEPENDENT KINETICS OF COUPLED-CORE REACTORS. C. G. Chezem and R. L. Seale (Los Alamos Scientific Lab., N. Mex.). July 1964. Contract W-7405-eng-36. 89p. Dep.; $3.00(OTS).

The kinetic behavior of arrays of nuclear reactors has been investigated. Included is the influence of temperature-reactivity effects. The coupling magnitude strongly influences the transfer function amplitude at all frequencies. The influence of the coupling lag time is apparent only at high frequencies, and significant effects are present only if α is high (~0.01) and the neutron lifetime is short. The temperature-reactivity effects are restricted to the low-frequency domain. No apparent limitations, induced by neutronics, on the use of coupled-core systems were discovered over the range of the parameters investigated. (auth)

10487 (LA-3166-MS) COMPUTATIONAL SURVEY OF HOMOGENEOUS WATER-MODERATED SYSTEMS. Peter M. Wallis (Los Alamos Scientific Lab., N. Mex.). Jan. 1964. Contract W-7405-eng-36. 41p. Dep.; $2.00(OTS).

The results of a calculational survey cover the critical sizes of homogeneous water-moderated systems fueled with ^{239}Pu, ^{233}U, and ^{235}U (at various enrichments). Also included are ^{235}U enrichment values of water-moderated, low-enrichment uranium mixtures for which $k_\infty = 1$. (auth)

10488 (ORNL-TM-993) TRANSIENTS INDUCED BY PULSED NEUTRON SOURCES IN MULTIREGION REACTORS. C. A. Preskitt and E. A. Nephew (Oak Ridge National Lab., Tenn.). Jan. 1965. Contract W-7405-eng-26. 71p. Dep.(mn); $3.00(cy), 2(mn) OTS.

A matrix formulation is applied to the problem of transients induced by the pulsed operation of neutron sources. The spatial dependence of the flux is calculated as a function of time in a multiregion reactor of arbitrary composition. The theory of the transient response is presented in detail, and a computer program is described, which is used to compute solutions for a variety of practical applications. (auth)

10489 (RT/FI(64)-19) FISSION-PRODUCT POISONING IN FAST REACTORS. M. Marseguerra and E. Menapace (Italy. Comitato Nazionale per l'Energia Nucleare. Centro di Calcolo, Bologna). Oct. 1964. 19p. (CONF-193-10) Dep.(mn).

From 8th Nuclear Congress, Rome, June 1963.

A method for solving the fast reactor poisoning problem is given. Starting from the knowledge of a calculated cross section set, the entire energy range was divided in intervals and a new set of approximate cross sections was introduced, whose principal feature is that all the cross sections have the same energy dependence in each interval. Then two spectral indexes per energy interval have been introduced, so that any average cross section is a linear combination of known coefficients and unknown spectral indexes. Writing the fission product balance equations and making use of a matrix method, the solution turns out to be a product of given spectrum-independent matrices by spectrum-dependent column matrices. Once the spectral indexes have been calculated for a given spectrum, the poisoning problem may be rapidly solved. (auth)

10490 (UCRL-7686) A STUDY OF BERYLLIUM OXIDE MODERATED CRITICAL ASSEMBLIES CONTAINING VARIOUS METAL ABSORBERS. John R. Morton, III, James M. Plowaty, Joseph Petruzzi, and Loren Gardner (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 5, 1964. Contract W-7405-eng-48. 19p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Reactivity worths of various metal plates were measured in a quasi-homogeneous enriched uranium–beryllium oxide subcritical assembly by means of the pulsed neutron method. The materials studied included nickel, iron, cobalt, gold, Hastelloy R-235, and René-41. The equivalences were determined between the various absorbers and fueled core material. Based upon the measurements it was concluded that the prompt lifetime is relatively insensitive to massive localized absorbers. (auth)

10491 ON THE CALCULATIONS OF WATER-COOLED WATER-MODERATED REACTORS. E. A. Garusov and Yu. V. Petrov. At. Energ. (USSR), 17: 375-9(Nov. 1964). (In Russian)

An expression is obtained for the probability of leakage escape for reactors with uniform energy production. On the basis of the analysis of this probability, and also of the Fourier components of the experimental slowdown function and the slowdown functions of various diffusion models for ordinary water, a conclusion is made on the sufficient accuracy of the one-group model for calculation of active zones containing not less than 10 l of water. Increasing the number of energy groups without changing to the nondiffusion theory decreases the accuracy. (tr-auth)

10492 STATISTICAL EQUATION FOR REACTOR KINETICS. A. B. Govorkov. At. Energ. (USSR), 17: 474-8 (Dec. 1964). (In Russian)

The ordinary kinetic equation for describing the mean prompt neutron behavior in a reactor was supplemented by an equation for flux density that describes the statistical prompt neutron behavior. A method is given for effectively averaging statistical reactor behavior by taking into account the spatial and energy distributions of neutrons. The theory of the Rossi α-experiment was analyzed. (tr-auth)

10493 THE EFFECT ON THERMAL UTILIZATIONS OF A SPATIALLY VARYING SOURCE. Jeffery Lewins. J. Brit. Nucl. Energy Soc., 3: 307-10(Oct. 1964).

Thermal utilization in a lattice cell can be calculated conventionally using a source that is uniform in the moderator and vanishes in the fuel. This assumption may be suspected if the fuel region contains a moderating coolant or for a wide lattice pitch such that there is a non-uniform source of thermal neutrons in the moderator. The adjoint equations were used to determine the effect on thermal utilization. It is shown that it is not only easier to solve the adjoint equation than the equation with a varying source but that one adjoint solution serves to compare the effect of several source distributions. The diffusion theory solution is given and thermal utilizations calculated for various source distributions. The results suggest that in graphite the conventional assumption is good but that for a uranium–water system a non-uniform source changes the thermal utilization appreciably. (auth)

10494 PULSED SOURCE METHODS IN FAST REACTOR PHYSICS. W. J. Paterson and J. W. Weale (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Brit. Nucl. Energy Soc., 3: 311-19(Oct. 1964).

Pulsed-source methods of measuring the prompt chain decay constant, α, and the lower range neutron energy spectrum of a fast reactor are described. The methods are illustrated in terms of experimental results recently obtained on the zero-energy reactor, Vera. The α results were in good agreement with Rossi-α measurements but the observed variation of α with reactivity was not in agreement with simple theory. The neutron energy spectra were measured by time-of-flight in the range from 100 ev to 50 kev and there was some evidence from spectral-index measurements that the spectrum in the extracted neutron beam corresponds closely with the reactor core spectrum. (auth)

10495 MEASUREMENT OF THE INFINITE MULTIPLICATION FACTOR IN A NATURAL URANIUM, LIGHT-WATER LATTICE. T. W. T. Burnett and T. G. Williamson (Univ. of Virginia, Charlottesville). Nucl. Sci. Eng., 21: 201-5(Feb. 1965).

The infinite multiplication factor, k_∞, is one of the basic parameters of a subcritical assembly. Usually, these assemblies are designed for maximum k_∞; however, it is difficult to conduct laboratory experiments which yield a value of k_∞ to reasonable accuracy. Common methods, such as the loading technique and exponential experiment, are of doubtful validity or require apparatus not always available. Pulsing techniques are widely accepted, but are difficult to apply to reflected assemblies. An alternative approach is used. It is based on the integration of the thermal-neutron flux over the equivalent infinite medium. Use of variations in the method with poisoned assemblies eliminates the need for accurate determinations of the source strength, the absolute thermal-flux calibration, and the epithermal parameters of the medium. The theory is general and can be applied with a minimum of equipment. The results obtained from this method (and its variations) were checked by pulse measurements on the bare assembly and by a four-factor formula calculation. All results agree to within 2%. (auth)

10496 CRITICALITY OF SLIGHTLY ENRICHED URANIUM IN WATER-MODERATED LATTICES. C. R. Richey, R. C. Lloyd, and E. D. Clayton (General Electric Co., Richland, Wash.). Nucl. Sci. Eng., 21: 217-26(Feb. 1965).

Exponential and approach-to-critical experiments were conducted with slightly enriched uranium in light water. The uranium was fabricated into elements of 0.175 to 1.66 in. diam with enrichments of 1.007 to 3.063 wt % ^{235}U. Exponential measurements were also made with natural uranium rods (0.925 in. diam) in light water. Analytical methods were used to correlate the experimental results and extend the data to include uranium rods containing 4.0 and 5.0 wt % ^{235}U. (auth)

10497 THEORY OF DOPPLER COEFFICIENTS OF FAST REACTORS INCLUDING THE MUTUAL SCREENING OF RESONANCES. R. Froehlich. Thesis, Karlsruhe, Ger., Technische Hochschule, 1964. 81p. $2.00(Gmelin, AED-DISS. 64-38). (In German)

The influence of the interaction of resonances on Doppler coefficients is studied. A new method for calculations was applied to 2 fast reactor systems. The precision of calculations is discussed in detail. (Gmelin Inst.)

10498 A STUDY OF DISTRIBUTED PARAMETERS IN NUCLEAR REACTOR KINETICS. Albert Eugene Wilson. Thesis, Norman, Okla., Univ. of Oklahoma, 1964. 121p.

Semi-empirical equations are developed, which are useful in the experimental studies of the frequency response of nuclear reactors. Specifically, these equations may be used to calculate the frequency response of a compact-core nuclear reactor from experimental measurements made in a moderating medium outside the core region. Such calculations should find application in a study of power reactor kinetics since measurements inside the core are generally precluded due to core complexity and adverse environmental conditions. The equations are based on a two-energy, time-dependent, diffusion model without assuming separability of time and space functions. The form of the solution is predicted by the physical properties of the system and by physically realizable boundary conditions. The results of experimental studies are included to verify the model for the particular reactor system available for study. Considerations for the extension of the equations with applications to other systems are discussed. (Dissertation Abstr., 25: No. 3, Sept. 1964)

Design and Feasibility

10499 ANALYSIS OF A NUCLEAR REACTOR SUPPORT STRUCTURE. A. H. Marchertas (Argonne National Lab., Ill.) and G. M. Smith. J. Spacecraft Rockets, 1: 247-52(May-June 1964).

A general solution is presented for the deformation of a circular grid support structure, which consists of two parallel perforated plates positioned one above the other and interconnected by a large number of tubes. The solution is based on a modified shape function for a circular plate which may be subjected to any degree of edge restraint, ranging from fixed to simple supports. The Rayleigh-Ritz method is used in conjunction with the Lagrangian multiplier associated with the degree of edge restraint. The complexity introduced by the holes in the two plates is circumvented by the use of two equivalent solid plates. The solution is given in terms of a set of simultaneous algebraic equations with a general expression for the coefficients. (auth)

Fuels

Refer also to abstracts 9056, 9060, 9440, and 9595.

10500 (BAW-3125-2) NONUNIFORM TEMPERATURE EFFECTS ON THORIUM RESONANCE ABSORPTION. Quarterly Progress Report No. 2, July 1 – September 30, 1964. W. G. Pettus and M. N. Baldwin (Babcock and Wilcox Co. Critical Experiment Lab., Lynchburg, Va.). Work Performed under United States – Euratom Joint Research and Development Program. Contract AT(30-1)-3125-2. 22p. (EURAEC-1257). Dep.(mn); $1.00(cy), 1(mn) OTS.

The effect of nonuniform temperature distributions on the neutron resonance capture integral of thorium metal and oxide rods is being studied. Suitable thermal chambers and heating and cooling systems are being developed. The designed thermal chambers allow the experiment to be conducted under an inert atmosphere, and a helium-cooled connector was developed to prevent burnout of the section of the heater exposed by thermal expansion. Fabrication of the thorium oxide pellet samples was completed, and activation measurements on these samples are under way. Resonance capture measurements were made on the axially heated samples having radial temperature drops up to 300°C. Corresponding measurements at uniform temperatures up to 350°C were also made. Data from these measurements will not be available for several weeks because the counting samples must be dissolved and chemically separated. Additional thorium oxide measurements are planned to give radial temperature drops up to 1000°C. In the measurements on thorium metal, the maximum radial temperature drop will be determined experimentally. (auth)

10501 (BLG-231) EVALUATION DE LA COMPOSITION ISOTOPIQUE EN ELEMENTS LOURDS ($z \geq 92$) DES ELEMENTS COMBUSTIBLES BR2 IRRADIES. (Evaluation of the Isotopic Composition of Heavy Elements ($z \geq 92$) in Irradiated BR2 Fuel Elements). A. Siebertz (Centre d'Etude de l'Energie Nucleaire, Brussels). Apr. 1963. 33p. Dep.(mn)

The amounts of heavy nuclides from uranium-234 to curium-245 in the BR2 fuel elements during and after irradiation were estimated. Two typical irradiation cycles in the BR2 are considered. Calculation methods and assumptions concerning the effective cross sections of the heavy nuclides in the BR2 are given. (auth)

10502 (CEA-R-2569) TRANSFERT THERMIQUE UO_2-GAINE APPLICATION AU CAS DE L'ELEMENT COMBUSTIBLE DU 1er JEU EL 4. (UO_2-Can Thermal Transfer. Application to the Case of the First EL 4 Batch of Fuel Elements). Claude Ringot, Armand Faussat, and Ghislain De Contenson (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay). Aug. 1964. 53p. Dep.(mn).

The UO_2-can thermal transfer is one of the most important factors affecting the operational working of fuel elements. A systematic study of the elements influencing the heat transfer coefficient has been undertaken; in particular, the effects of the contact pressure and of the gas filling pressure have been studied. Tests have been carried out using planar and cylindrical geometrical shapes. Using the values obtained and the integral conductivity curve for UO_2, a calculation has been made of the evolution of the EL 4 fuel element during its life-time, if it is assumed that the fusion gas occupies a free volume of 2.5 per cent at the end of the fuel element and of zero or 2 per cent in the UO_2. (auth)

10503 (CEA-R-2573) CONTRIBUTION A L'ETUDE DES DEFORMATIONS DES GAINES DES ELEMENTS COMBUSTIBLES DE REACTEUR GRAPHITE-GAZ AU COURS DU CYCLAGE THERMIQUE. (Contribution to the Study of Can Deformations in the Fuel Elements of Gas–Graphite Reactors During Thermal Cycling). Maurice Gauthron, Bernard Boudouresques, and Paul Delpeyroux (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay). Aug. 1964. 59p. Dep.(mn).

The cans of fuel cartridges used in reactors of the gas-graphite type have either longitudinal fins of variable thickness, short herring-bone fins, or else a mixture of the two. An important test of the strength of these cartridges is their behavior during thermal cycling carried out in cells reproducing in-pile conditions. It has been observed during rapid cooling that there occurs a shortening at the base of the fins which can be accompanied in particular by a compression effect at the fin tip, which has a tendency to curl, and by a tractive force acting on the body of the can at the ends of the longitudinal fins; this last phenomenon can result in a fracturing of the welds at the extremities or of the ends of the cartridge. The way in which the stress diagram can be drawn for a can touching the fuel and the effect of the ratchet along a fin fixed to a bar with or without grooves are discussed. Finally the importance of the test cycling variables (temperature, heating, and cooling rates) is shown. (auth)

10504 (CEA-R-2574) ETUDE DE LA CHUTE THERMIQUE AU CONTACT URANIUM GAINE POUR DES ELEMENTS COMBUSTIBLES DE REACTEUR DE LA FILIERE GRAPHITE-GAS. (Study of the Thermal Drop at the Uranium-Can Interface for Fuel Elements in Gas–Graphite Reactors). Armand Faussat (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay), Guy J. Levenes, and Marcel Michel (Société Industrielle de Combustible Nucléaire, Paris). Aug. 1964. 38p. Dep.(mn).

A review is given of the tests now under way for determining the thermal contact resistance at the uranium-can interface for fuel elements used in gas-graphite type reactors. These are laboratory tests carried out with equipment based on the principle of a heat flow across a stack of test pieces having planar contact surfaces. The following points emerge from this work: For a metallic uranium element canned in magnesium, of the type G_2 or EDF2, a value of 0.2°C/w/cm^2 seems reasonable for can temperatures of 400°C and above. This value is independent of the micro-geometric state of the uranium surface in a range of roughness which easily includes those observed on tubes and rods produced industrially. For the internal cans of elements cooled internally and externally, the value of the contact resistance for temperatures of under 400°C as a function of the stresses in the can has not yet been measured exactly. (auth)

10505 (CEA-R-2576) ETUDE DE LA TENUE DE LA GAINE INTERNE POUR ELEMENT COMBUSTIBLE A REFROIDISSEMENT INTERNE ET EXTERNE D'UN REACTEUR GRAPHITE-GAZ. (Study of the Strength of the Internal Can for Internally and Externally Cooled Fuel Elements for Gas-Graphite Reactors). Bernard Boudouresque, Paul Courçon, and Guy Lestiboudois (France. Commissariat à l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). Aug. 1964. 34p. Dep.(mn).

The cartridge of an internally and externally cooled annular fuel element used in gas-graphite reactors is made up of a uranium fuel tube, an external can, and an internal can made of magnesium alloy. For the thermal exchange between the internal can and the fuel to be satisfactory, it is necessary for the can to stay in contact with the uranium under all temperature conditions. A theoretical study shows how the internal can-fuel gap varies during the processes of canning, charging into the reactor, and thermal cycling. The following parameters are considered: tube diameter, pressure of the heat-carrying gas, gas entry temperature, plasticity of the can alloy. It is shown that for all operating conditions, the internal can of a 77 × 95 element, planned for a gas-graphite reactor with a 40 kg/cm^2 gas pressure, should remain in contact with the fuel. (auth)

10506 (CRR-861) THE DETERMINATION OF U^{235} BURN UP BY COUNTING METHODS. C. B. Bigham, G. C. Hanna, and P. R. Tunnicliffe (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1959. 70p. (AECL-924). Dep.(mn); $1.50 (AECL).

A description is given of measurements of the burnup of ^{235}U in samples of irradiated natural uranium by fission and alpha counting. Attempts were made to measure the $^{235}U/^{238}U$ ratio to 0.1 per cent, in order to obtain an accuracy of 1 per cent or better in the burnup for irradiations exceeding 1000 Mwd/t. This accuracy was not achieved. Although, with further development, it probably could be, the method is cumbersome. As a by-product of this work, effective values of $\alpha(^{235}U)$ and $\hat{\sigma}_a(^{234}U)$ in NRX rods were obtained. The results are $\alpha(^{235}U) = 0.187 \pm 0.003$ and $\hat{\sigma}_a(^{234}U) = 144 \pm 7$ barns. (auth)

10507 (DP-928) CALCULATION OF HIGH-ENERGY EVENTS IN THERMAL REACTORS. II. A COMPUTER CODE—HEETR. Hugh K. Clark (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Nov. 1964. Contract AT(07-2)-1. 48p. Dep.; $3.00(OTS).

A FORTRAN code is described that computes high energy events in thermal reactors having cylindrical fuel elements. The HEETR code is based on transmission and escape probabilities. Code calculations are compared with experimental determinations of the ratio of ^{238}U to ^{235}U fissions for lattices of natural uranium tubes and rod clusters in D_2O. Good agreement is obtained for lattices of single rods, but code calculations tend to exceed experimental values for lattices of tubes and rod clusters. (auth)

10508 (GEAP-3376) PRE-IRRADIATION DATA ON N. S. *SAVANNAH* CORE II-4, -5, AND -6 PROTOTYPE FUEL ASSEMBLIES TO BE TESTED IN VBWR. N. S. *SAVANNAH* FUEL DESIGN AND DEVELOPMENT PROGRAM. R. G. Cochran (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Apr. 26, 1960. Contract AT(04-3)-189. 24p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Fabrication and pre-irradiation data are given for the N. S. *Savannah* Core II-4, -5, and -6 VBWR irradiation test fuel assemblies. The information will be utilized as a basis for comparison with results of the final post-irradiation examination of this fuel. (auth)

10509 (GEAP-3376(Add.)) PRE-IRRADIATION DATA ON N. S. *SAVANNAH* CORE II-4, -5, and -6 PROTOTYPE FUEL ASSEMBLIES TO BE TESTED IN VBWR. N. S. *SAVANNAH* FUEL DESIGN AND DEVELOPMENT PROGRAM. E. Mangrum, Jr., and F. H. Megerth (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 1, 1960. Contract AT(04-3)-189. 20p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Fuel assemblies #4 and #5, which are included in the *Savannah* Core II Fuel Irradiation Program, were modified to increase the experimental variables originally planned. The modification for the fuel segments included in these assemblies is described. (auth)

10510 (GEAP-4716) ACCURATE NUCLEAR FUEL BURNUP ANALYSES. Eleventh Quarterly Progress Report, June–August 1964. B. F. Rider, J. P. Peterson, Jr., C. P. Ruiz, and F. R. Smith (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 1, 1964. Contract AT(04-3)-189. 33p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Mass spectrometric analysis of stable fission product isotopes is being studied as a means to improve accuracy. One of the most promising of such isotopes is ^{148}Nd. Many of the uncertainties in the use of this isotope as a total fission burnup indicator have been resolved. Cross-sectional measurements on ^{148}Nd have been completed and the cross section has been found to be low enough to permit burnup measurements to be made to very high exposures. The final value for the thermal neutron absorption cross section is 2.54 ± 0.18 barns, and the resonance neutron capture integral, Σ, above the cutoff of 0.43 ev for a 20-mil cadmium filter (including the $1/v$ portion) is 18.7 ± 1.5 barns. These values were obtained from measurements of the activation product ^{149}Nd. During the course of these measurements, some observations were made on the decay scheme of this nuclide for which a gamma ray intensity of $(7.2 \pm 0.3)\%$ was obtained for the 650-kev gamma ray. By use of this value, the absolute intensities of the other prominent gamma rays were obtained. The primary separation of neodymium from fuel has been greatly simplified by use of alcoholic HNO_3 eluant on a single Dowex-1 anion exchange column in place of three other types of columns formerly required. A primary neodymium standard solution was prepared for interlaboratory calibration. Measurements on the ^{233}U, ^{239}Pu, and ^{235}U thermal fission yield of neodymium isotopes relative to ^{148}Nd are reported. (auth)

10511 (HW-74539) FEFC—FUEL ELEMENT FABRICATION CODE. D. E. Deonigi (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 1964. Contract AT(45-1)-1350. 63p. Dep.; $3.00(OTS).

FEFC, the Fuel Element Fabrication Code programmed for the IBM 7090, provides a method for engineering personnel to calculate fuel element fabrication costs by using data most readily available during early stages of plant design. The code may also be used to evaluate changes in the fabrication methods of an existing plant as they affect costs in an individual job or in the entire process. Following a description of the code is a listing of the source deck and an illustration of the codes use. (auth)

10512 (HW-81601(p.3.1-27)) FUELS DEVELOPMENT. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Twelve UO_2-PuO_2 fuel elements were fabricated and delivered to the PRTR. All EBWR, UO_2–1.5 wt % PuO_2 fuel rods required for physics tests were fabricated and delivered. UO_2 processing studies revealed that desired O/U ratios for pneumatic impaction can be obtained by controlling oxide particle size distribution and roasting conditions. Revised powder preparation techniques increased fuel utilization while reducing processing time. As the O/U ratio increased, the density of pneumatically impacted UO_2-PuO_2 increased. Gas-forming impurities in depleted UO_2 were responsible for the low densities (94.4% TD) achieved by pneumatic impaction. Heat treatment of the UO_2 in hydrogen containing water vapor for 6 hr at 1700°C eliminated the gas-forming impurity and permitted the attainment of impacted densities of about 99.0% TD. Zircaloy end cap sections of PRTR cladding tubes were heated in an Ar–8% H atmosphere. Catastrophic hydriding occurred after 16 hr at 425°C. A recovery yield of 74% was obtained by honing tubes containing burrs produced by air-gauging operations. Fabrication of the first inverted cluster fuel element for the PRTR was completed and the element successfully irradiated. Using a ternary mix specified by a theoretical model for particle packing, four small diameter rods containing W–26% Re heater wires centrally located in a UO_2 fuel column, were vibrationally compacted for experimental studies to a UO_2 density of 84–85% of theoretical. Theoretical models to describe the packing of particles were developed, and the validity of these models corroborated in the fabrication of fuel elements that differed significantly in size and shape. A unique spiral machining process was developed to fabricate thin Pu–Al alloy disks for critical experiments in the PCTR. Results indicate that dry ball-milling followed by pneumatic impaction offers a relatively simple and inexpensive means of preparing UO_2-PuO_2 fast reactor fuel that meets often quoted criteria of particle size and PuO_2 distribution. Alpha autoradiographs of impacted UO_2–20 wt % PuO_2 mixtures that were ball-milled 32 and 64 hr revealed a uniform distribution of alpha tracks, comparable to that obtained with coprecipitated and sintered $(U,Pu)O_2$. Stainless steel clad cermet cores, with and without powdered metal end caps, were fabricated by the one-shot pneumatic impaction process. A mixture of nickel-coated PuO_2 and BeO was pneumatically impacted. Standards, consisting of gold and lithium alloys, for reactor physics experiments are being fabricated. (auth)

10513 (HW-81601(p.4.1-30)) FUELS TESTING AND ANALYSIS. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Maximum burnups of UO_2 and UO_2-PuO_2 packed-particle fuel elements in the PRTR are 1.52×10^{20} fissions/cm^3. A full-length, vibrationally compacted UO_2 inverted cluster fuel element was successfully irradiated in the PRTR Rupture Loop. A pin-hole failure developed in a Zircaloy-clad, swage-compacted UO_2-PuO_2 PRTR fuel rod after an average burnup of 1.26×10^{20} fissions/cm^3. Plutonium, originally introduced as a 0.102 cm (0.040 in.) diameter Pu–15 wt % Zr wire, became uniformly distributed throughout the center third of the fuel during irradiation of the wire enriched fuel element. Tests were performed to evaluate the effect of iodine on the behavior of Zircaloy-2 exposed to high stress at elevated temperatures. No stress cracking was found in tests evaluating concentrations of iodine expected from exposure in the PRTR for 300 days at 8.5×10^{20} nvt. Twenty-two, vibrationally compacted, impacted UDO_2–1.5 wt % PuO_2 capsules are being irradiated. Ten were discharged. Maximum exposures achieved are 1.1×10^{20} fissions/cm^3 (7100 Mwd/ton UO_2) and 2.2×10^{20} fissions/cm^3 (3700 Mwd/ton UO_2), respectively. The satisfactory irradiation performance of $(Th,Pu)O_2$ pellets was demonstrated to maximum burnups of 3×10^{20} fissions/cm^3 at maximum power generation rates of 1200 w/cm (molten core). The central fuel temperature of an instrumented ThO_2 fuel element increased from 480°C to 1050°C during a two-cycle irradiation in the MTR. Gas release from irradiated thoria increased with increasing exposure and surface area. Two capsules containing pneumatically impacted UN were irradiated at rod powers up to 1150 w/cm. No in-reactor sintering of the UN occurred. (auth)

10514 (HW-83431) ANALYSIS OF MTR CYCLE 108—LOW-EXPOSURE PLUTONIUM CORES. J. J. Regimbal (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 9, 1964. Contract AT(45-1)-1350. 64p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Of the three major computations carried out in this study, two were completed with satisfactory results. The reactor model, basic data and computational methods appear to be quite adequate for reproducing the measured multiplication for both the reactor physics core and the (Mwd = 0) power core. The reactor physics system, based on calibrated shim rods, had a "rods-out" multiplication of 1.196. A computed value of 1.191 was obtained. The power core initial "rods-out" multiplication of 1.128 has been exactly duplicated. This is quite fortuitous since some further corrections of the order of 1.0% probably would be introduced in a more detailed calculation. The computation of the burnup reactivity transient for the power core remains unsatisfactory, because of the inadequacies of the augmented one-dimensional model used. Improvement in the calculation will largely depend upon how well the flux distortions resulting from partial shim rod insertions are approximated. Probably an explicit three-dimensional model is required. (auth)

10515 (HW-SA-3772) TECHNOLOGY FOR PLUTONIUM FUELS IN THERMAL REACTORS. F. W. Albaugh (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 10, 1964. Contract AT (45-1)-1350. 34p. (CONF-773-6). Dep.(mn); $2.00(cy), 1(mn) OTS.

Because of the planned termination of U. S. Government buyback of Pu on Jan. 1, 1971, plans must be made for subsequent disposal of Pu, such as recycle in thermal reactors. A review is presented of the state of Pu fuel utilization technology for thermal reactors in U. S. Fuels development, physics, cycle analyses, and chemical processing are discussed. (D.L.C.)

10516 (UCRL-12064) CRUD—A FISSION-PRODUCT DIFFUSION CODE FOR THE CDC 3600 AND IBM 7094. G. M. Litton and C. R. Hunt (California. Univ., Livermore. Lawrence Radiation Lab.). Sept. 1, 1964. Contract W-7405-eng-48. 41p. Dep.; $2.00(OTS).

The CRUD program solves the equations describing fission product diffusion in slab-geometry fuel elements. Decay chains with up to nine members may be treated. The fission source for any isotope must be spatially uniform but may be assigned an arbitrary time dependence. The primary output of the code is time-dependent concentration profiles and leakage rates for each species of a decay chain. Arbitrary initial concentration profiles may be assigned to the chain members. The code contains an option for the inclusion of recoil effects. (auth)

10517 (WCAP-3385-1) SAXTON PLUTONIUM PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING SEPTEMBER 30, 1964. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Oct. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-3385. 75p. (EURAEC-1256). Dep.(mn); $3.00(cy), 2(mn) OTS.

Information is being developed on the utilization of plutonium enriched fuel in pressurized water reactor systems, through design, fabrication, and operation of a partial core of plutonia-urania fuel in the Saxton Reactor. In-pile performance of this fuel will be evaluated and post-irradiation examination of fuel samples will be made. Performance will be analyzed and compared with analytical predictions. Prior to loading, critical experiments will be conducted to evaluate nuclear design methods and to predict reactivity and power distribution of the fuel rods in the Saxton core. Prior to startup, a series of zero and low power physics measurements will be made to verify reactivity, control rod and boron worth, flux and power distribution, and temperature and power coefficients. These characteristics, as well as core thermal and hydraulic performance, will also be measured at intermediate and full power levels. Similar data will be obtained during shutdowns to determine characteristic changes with irradiation. (N.W.R.)

10518 (EURAEC-1005) THE NUCLEAR VAPOTRON. Ph. De Mange, E. Douguet, and J. D. Lefranc (Compagnie Française Thomson-Houston, Paris). May 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 050-62-5-RDC. 30p. (EUR-1753.f). Dep.(mn); $2.60(fs), $1.10(mf) JCL.

Reprinted from "Revue Technique C.F.T.H.," No. 38, p.107-30, May 1963.

After recapitulating the principal aspects of the boiling of a liquid in contact with an isothermal wall, an analysis is presented of the principle governing the functioning of the vapotron, which integrates these various mechanisms into a composite assembly of high efficiency. Initial results obtained in conditions of experiment compatible with nuclear utilization of this process, which deliberately diverge from the conventional solutions, are noted. These initial results are encouraging. (auth)

10519 OPERATING EXPERIENCE WITH AN EXPERIMENTAL NUCLEAR HEATED THERMIONIC CONVERTER. C. A. Busse, R. Caron, and C. M. Cappelletti (Euratom CCR, Ispra, Italy). Advan. Energy Conversion, 4: 121-6 (Nov. 1964).

A rig was developed for the testing of nuclear heated thermionic converters, which allows direct determination of the converter efficiency by measuring the waste heat flow through three thermal bridges. A 50 hr in-pile test of the device was performed. The converter consisted of a cylindrical molybdenum emitter and a niobium collector, with an electrode spacing of 0.5 mm. The emitter was heated by radiation from a (UZr)C fuel pin. The converter operated for 45 hr, with electric power outputs between 30 and 40 w for most of the time, and with efficiencies of up to 11 per cent. At the end of this period a permanent partial short occurred in the converter. (auth)

10520 BURNUP OF NATURAL URANIUM IN AXIAL MOTION IN A REACTOR. V. Bartoshek and V. Lelek (Inst. for Nuclear Research, Czechoslovak Academy of Sciences, Řež). At. Energ. (USSR), 17: 380-4(Nov. 1964). (In Russian)

A study is made of the effect of continous fuel movement in an axial direction to the neutron flux distribution and of the burnup of natural uranium in a heavy water reactor. On the basis of a simplified model taking into consideration the dependence of the neutron multiplication factor on the U burnup, it is shown that the region with U movement in one direction increases burnup approximately 20% in comparison with the region of continuous overload of fuel elements and improves the heat-engineering conditions of their performance. The region with contrary motion of fuel increases the U burnup 40%, while the heat-engineering conditions of heat removal from the elements almost do not change. (tr-auth)

10521 AN INTEGRAL CONCEPT FOR MAGNOX FUEL. K. E. G. Meredith (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc., 3: 241-3(Oct. 1964).

An integral concept for canning magnox nuclear fuel in which the uranium is encapsulated with canning material in one piece was demonstrated experimentally and offers the possibility of more economical higher integrity fuel elements. (auth)

10522 ESTIMATING THE PERFORMANCE OF MAGNOX FUEL CANS USING THE ANALOGY BETWEEN FLUID FRICTION AND HEAT TRANSFER. M. A. P. Watson (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc., 3: 276-80(Oct. 1964).

An analogy was developed for predicting the average heat transfer performance of finned surfaces in axial flow from pressure loss measurements. The analogy was applied to the special case of the spiral polyzonal fuel can, typical of magnox reactors, and over a wide range of design the general level of accuracy compared with experimental results was better than 5%. The analogy was also shown to hold for a transverse-finned fuel can. In addition, a method for estimating the effects of temperature level is provided. (auth)

10523 SOME CONSIDERATIONS IN THE DESIGN OF FINNED SURFACES FOR MAGNOX FUEL ELEMENTS. F. Williams (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc., 3: 281-90(Oct. 1964).

The development of the finned surface for magnox fuel elements is surveyed. The inadequacy of information on fin efficiency is mentioned, and the various correlations available for predicting polyzonal performance are discussed. Experimental results are compared with predictions from correlations. It is suggested that three different heat transfer mechanisms, in addition to fin efficiency, should be considered when designing the best finned surface for a particular set of conditions. However, additional experimental information is required to assess the change in relative importance of these due to changes in geometry. The performance of several can designs is considered with reference to heat transfer mechanisms. (auth)

10524 POSSIBLE IMPROVEMENTS TO URANIUM–MAGNOX FUEL ELEMENTS. J. D. Noden (Central Electricity Generating Board, Berkeley, Eng.). J. Brit. Nucl. Energy Soc., 3: 291-300(Oct. 1964).

A number of possible improvements, which could be made to future and replacement uranium/magnox fuel elements, are described. Investigations into the occurrence of fast burst failures are described; methods are proposed to eliminate such failures by the use of protected end welds and by insertion of a radioactive gas, ^{85}Kr, into the element at manufacture to detect unsound fuel elements at the reactor 'charge face' prior to charging. An alternative method of manufacture of the splitter cage assembly of the polyzonal element is described. Details are given of a method of manufacture of fuel elements by complete encapsulation of the fuel with elimination of fusion welds. In addition, work leading to improvement of the uranium/magnox fuel element heat transfer characteristics, by alignment of adjacent fuel elements in a channel, is described. (auth)

10525 FURTHER LARGE-SCALE MODEL INVESTIGATIONS INTO FACTORS AFFECTING HEAT TRANSFER PERFORMANCE OF POLYZONAL SPIRAL FUEL ELEMENT CANS USED IN GAS-COOLED NUCLEAR POWER REACTOR SYSTEMS. S. B. H. C. Neal and J. A. Hitchcock (Central Electricity Research Labs., Leatherhead, Eng.). J. Brit. Nucl. Energy Soc., 3: 301-6(Oct. 1964).

Work was previously reported on a large scale model, which established the basic causes of the variation in heat transfer along the length of a polyzonal spiral fuel element can. The way in which the presence of an upstream can, splitter braces, and spring-loaded can end-fittings modified the basic pattern of heat transfer is described. The development of methods of improving can performance is discussed. Results showed that it is possible to increase considerably the heat transfer from a polyzonal type fuel element can. (auth)

10526 TUBULAR FUEL ELEMENT FOR NUCLEAR REACTOR. Bernard Boudouresques (to Commissariat a l'Energie Atomique). British Patent 972,466. Oct. 14, 1964. Priority date Oct. 26, 1962, France.

A fuel element for a nuclear reactor consisting of a tubular rod of fissionable material clad internally and externally with metal sheaths connected by an annular plug is described. At least one sheath, cylindrical in its central portion, is flared at its end portion, and a disc is shaped to fit in the flared end so that the contacting area between a plug closing the inner sheath and the disc is greater than the cross sectional area of the tubular rod of fissionable material. One of the faces of the plug may be provided with asperities such as circular grooves or corrugations in order to prevent radial distortion. Thrust loads resulting from stacking of fuel elements are thus distributed over a greater surface, and resistance to creep is increased. (A.G.W.)

10527 FUEL ELEMENT. Kurt Katz (to U. S. Atomic Energy Commission). U. S. Patent 3,167,482. Jan. 26, 1965.

A patent is described relating to a fuel element for a nuclear reactor which is capable of producing thermoelectric power. The fuel element consists of two metal plates which are separated by an insulator and which contain thermoelectric junctions consisting of a pair of contacting wafers of uranium oxides of different O content with each wafer contacting only one plate. The uranium oxide of one wafer is an n-type semiconductor and the uranium oxide of the other wafer is a p-type semiconductor. (AEC)

Power and Power-Breeder Reactors

Refer also to abstract 10648.

10528 (ACNP-64015) PATHFINDER ATOMIC POWER PLANT. FUEL HANDLING AND TRANSFER SYSTEM DEVELOPMENT. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Bethesda, Md.). Sept. 28, 1964. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 122p. Dep.(mn); $4.00(cy), 3(mn) OTS.

The Pathfinder Atomic Power Plant includes a boiling water reactor with an integral nuclear superheater. The design of the refueling system for the reactor is summarized. (auth)

10529 (ACNP-64601) PATHFINDER ATOMIC POWER PLANT. PATHFINDER BOILER CORE: SLAB EXPERIMENT TEST 301. C. Larson, P. S. Lacy, and R. Nirschl (Allis-Chalmers Mfg. Co. Atomic Energy Civ., Bethesda, Md.). Sept. 1, 1964. For Northern States Power Co., Minneapolis and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 29p. Dep.(mn); $2.00(cy), 1(mn) OTS.

A test was performed to provide information on the validity of the nuclear design model used for Pathfinder and to approach the Pathfinder full-core loading in a safe manner. The test determined the minimum critical number of reference 2.2 wt % U-235 enriched fuel assemblies in a rectangular slab array. Information was also obtained on the reactivity worth of additional boiler fuel assemblies. Analytical results of preliminary calculations, experimental results of the test, and final post-experiment comparison of test results with analytical results are included. (auth)

10530 (BLG-255) A DYNAMICAL MODEL FOR THE SIMULATION OF THE BR3 STEAM GENERATOR. G. H. Spauwen and J. F. de Greef (Centre d'Étude de l'Énergie Nucléaire, Brussels). Apr. 1964. 28p. Dep.(mn).

A set of simultaneous differential equations describing the thermodynamics of the BR3 steam generator is derived by applying the principles of conservation of energy and mass. A mathematical model is thus obtained for the dynamic and thermal behavior of the steam generator. This model has been programmed for an analog computer. Under the conditions of reactor power operation, the set of equations is solved by varying the output and input mass flows on the secondary side. (auth)

10531 (CEA-R-2578) REACTEUR EL 4. CHANGEMENT D'UN TUBE DE FORCE SUR BOUCLE D'ESSAI. (The EL4 Reactor. Changing of a Pressure Tube on a Test Loop). Henri Foulquier and Pierre Clara (France. Commissariat á l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). Aug. 1964. 18p. Dep.(mn).

Right from the beginning of the EL4 project, the research connected with the overall design of the reactor was guided by the various technical specifications resulting from a justifiable concern about the reliability. In particular, the external and internal tubes of each layer situated in the reactor block had to be interchangeable. The research alone into the dismantling of the external tube, i.e., the pressure tube, justified a certain number of full-scale tests on a model. The tests carried out under relevant conditions on a non-irradiated structure made it possible to define a complete range of positioning and impositioning sequences at a distance for such a pressure tube. (auth)

10532 (COO-279) AN EVALUATION OF FOUR DESIGN STUDIES OF A 1000-MWe CERAMIC-FUELED FAST BREEDER REACTOR. (Chicago Operations Office. Reactor Engineering Div.). Dec. 1, 1964. 115p. Dep.; $4.00 (OTS).

Four design studies of a 1000-Mwe fast breeder reactor were evaluated. The design studies were limited to the geometry, physics, thermal characteristics, and materials in the core; the reactor vessel; core instrumentation and mechanical devices for control and safety; and fuel handling mechanisms. The design of the remainder of the plant was not included in the scope of work of the study. However, a plant heat rate was given. The sodium flow rates of the heat removal system were to be calculated. In order to provide four separate, distinct conceptual designs, each designer worked independently of the others. (auth)

10533 (COO-652-9) PIQUA NUCLEAR POWER FACILITY MONTHLY OPERATING REPORT NO. 19. (Piqua, Ohio. Nuclear Power Facility). Nov. 1964. Contract AT(11-1)-652. 25p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The reactor operated continuously throughout the month. During the early part of the month, the maximum power level was limited by maintenance work in the plant. Information is included on: plant performance, process system data, fuel and reactivity status, testing and analysis, health and safety, and maintenance and modifications. (N.W.R.)

10534 (CVNA-216) SUPPLEMENTARY OPERATING REPORT, JUNE 16–SEPTEMBER 30, 1964. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). 54p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Several startup tests were completed during the early part of the period covered by this report; the major portion of the period, however, was devoted to steady load operation near licensed power. Generally speaking, it was felt that plant and components operated satisfactorily and that steady power operation could be prevalent. Routine maintenance was carried on during the entire period with no major problems appearing. Plant chemistry remained within specifications with only minor temporary fluctuations; the major point of interest in this area was the solution of the "fluoride problem" which had been present for some time. Radiation surveys indicate very low values behind shielding, and surface contamination has been fairly low where exposure was possible. Radiation exposure of plant personnel was generally very low, and waste disposal during the period was nominal. Comparison of data indicates no significant contribution to the environmental radioactivity as a result of plant operation. (auth)

10535 (CVNA-217) MONTHLY OPERATING REPORT [ON CVTR OPERATION], OCTOBER 1964. (Carolinas Virigina Nuclear Power Associates, Inc., Parr, S. C.). 31p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Operation of the CVTR continued at essentially full licensed power (44.3 Mw gross thermal) during the month of October. The generator was on the line for 727 hours and 13 minutes and the gross electrical generation was 7,325,000 kwh, the highest output to date. All light water and heavy water systems chemistry remained within specifications. Little or no degradation of heavy water purity occurred. No unusual radiation or radioactivity levels were encountered as a result of continued operation at power. All radioactive waste releases were within permissible limits and the radiation exposure incurred by plant personnel was minimal. The revision of the a-c power supply to the reactor plant has essentially been completed. Routine mechanical and electrical maintenance continued. A shutdown is planned for early in November, principally because nuclear fuel burn-up will require a change in the control rod withdrawal sequence at that time. Other necessary shutdown work and physics tests will also be performed. (auth)

10536 (CVNA-218) MONTHLY OPERATING REPORT, NOVEMBER 1964. (Carolinas Virginia Nuclear Power Associates, Inc., Parr, S. C.). 33p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Operation of the CVTR continued at essentially full licensed power (44.3 Mw) until November 10, 1964, when the reactor was shut-down. This scheduled shutdown was necessary because the nuclear fuel burn-up to date required the first in a series of planned changes in the control rod withdrawal sequence. These changes are made to achieve a more uniform burn-up of the core over its lifetime. Other necessary maintenance and test work including the inspection of Group III control rods was performed within the Vapor Container during this shutdown. The inspection of Group III control rods was made by the use of the Refueling Machine and its periscope. Effective preplanning and coordination resulted in low exposure of plant personnel during the shutdown period. Various reactor physics tests were conducted in the beginning of the shutdown and additional required testing was performed after completion of the shutdown before full power operation was resumed. The availability factor for November was 71.3%; the generator was on the line for 346.31 hours and the gross electrical generation was 3330.00 Mwh(e). (auth)

10537 (DP-899) LARGE HEAVY-WATER-MODERATED POWER REACTORS. An Engineering Feasibility Study. (Du Pont de Nemours (E. I.) & Co., Wilmington, Del.). Nov. 1964. Contract AT(07-2)-1. 143p. Dep.; $4.00(OTS).

The objective of this study was to develop a particular design concept for 3500 and 8300-Mwt heavy-water-moderated power reactors, cooled by heavy water or an organic liquid, in sufficient detail to form a judgment of their feasibility. During the study it was established that the plants can be designed and built as conceived; that the power costs will be in an economically competitive range; and that the plants can be operated safely and with the intended performance. (auth)

10538 (GEAP-4425) DEVELOPMENT AND FABRICATION OF ESADA-VESR MARK II SUPERHEAT FUEL. E. A. Lees, E. Esch, R. F. Kirby, H. S. Clair, V. E. Hazel, and C. N. Spalaris (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Sept. 21, 1964. Contract AT(04-3)-189. 79p. Dep.(mn); $3.00(cy), 2(mn) OTS.

The EVESR is a water-moderated, thermal-spectrum, superheat reactor containing 32 fuel assemblies. The desired steam outlet conditions from the fuel elements are 960 psi, 1000°F maximum at an average velocity of approximately 90 feet per second. To obtain these conditions, the maximum UO_2 temperature will be maintained at about 1800°F with a corresponding hot element cladding temperature of 1250°F and heat fluxes of 107,500 Btu/ft^2-hr. The fuel geometry is annular, cooled on both sides by steam from a fossil-fired boiler. Five fuel cladding materials were selected for testing simultaneously in the Mark II (initial) core. Materials used for the tubing and end plugs were selected on the basis of information gathered from fuel irradiations conducted in a special superheat loop in the Vallecitos Boiling Water Reactor. Alloys selected were Types 304 and 310 vacuum-melted grades, Incoloy 800, and Inconel 600. One assembly made from commercial Type 304 was included for experimental control purposes. Development work necessary to support the fuel design used in the Mark II core is described, as well as the detailed operations during fabrication of a fuel element. (auth)

10539 (GEAP-4573) DESIGN DEVELOPMENT AND FABRICATION OF EVESR 1st CORE FUEL BUNDLES. J. R. Fritz (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Mar. 1964. Contract AT(04-3)-189. 123p. Dep.(mn); $4.00(cy), 2(mn) OTS.

The design, development, and fabrication of the EVESR first-core fuel are described. (auth)

10540 (GEAP-4594) SOUTHWEST EXPERIMENTAL FAST OXIDE REACTOR DEVELOPMENT PROGRAM. First Quarterly Report, April–June 1964. K. M. Horst, ed. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). July 1964. Contract AT(04-3)-540. 63p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Development of the Southwest Experimental Fast Oxide Reactor from the start of the program on March 25, 1964, to the end of the fiscal quarter on June 26, 1964, is summarized. Preliminary information was calculated on the effects of the total reactivity and reactivity insertion rates on the prompt critical transients. Frequency ranges and displacements required for the oscillator experiments were investigated. Static reactivity temperature coefficients were calculated. Preliminary values of the errors in measurement that might arise from changes in reactor power, sodium temperature, reactivity, and fuel temperature were estimated in support of the planning for the static Doppler measurements. An analog computer model was prepared to predict SEFOR operating conditions and reactor behavior resulting from the SEFOR experiments. Physics calculations indicate that the SEFOR core mock-up in ZPR-III consisting of a two zone metallic fuel loading will have a negative Doppler coefficient. Physics calculations were performed with two codes, THERMOS and PDQ, to determine radial flux and power distribution expected in a fuel pin subjected to a TREAT transient. A sodium vapor test apparatus was fabricated and assembly is in progress. The test is designed to provide information on vapor deposition during the refueling operation in the refueling cell located above the reactor vessel. A 60-group set of cross sections, revised to conform to recent experimental data, was prepared for the core physics analysis. Values for the Doppler coefficient, axial expansion coefficient of reactivity, and the reflector control worth were determined for six core designs involving changes in core composition. Analyses were made to establish stress criteria for the design of structural core components. Preliminary layouts of the core components and fuel assembly were prepared. Operating characteristics of the core at 20-Mw were tentatively established. (N.W.R.)

10541 (GEAP-4703) NUCLEAR SUPERHEAT PROJECT. Twentieth Quarterly Report, May–July 1964. W. L. Fiock (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Aug. 1964. Contract AT(04-3)-189. 102p. Dep.(mn); $4.00(cy), 2(mn) OTS.

Examination of elements from ESH-1.1 was completed. The metallographic examination of clad specimens from rods A-2 (Incoloy), B(BONUS 348 stainless steel), and F(310 VM stainless steel) indicated no localized corrosion for any of these materials. The Incoloy clad exhibited a grain boundary precipitation consistent with the operating temperature. The brazed areas on rod B had no evidence of unbonding or localized corrosion. There was a compositionally disturbed layer of approximately 0.16 mil on rod F, and grain boundary precipitates. Tensile specimens cut from cladding of rods H (Incoloy) and I (Inconel) were tested to indicate trends due to irradiation. At room temperature both materials have higher strength and some loss in ductility. At elevated temperature (1100°F) Incoloy showed little change in strength, but the ductility decreased (~70%). Inconel, at elevated temperatures (1100 and 1300°F), exhibited a decrease in ultimate stress and nil ductility at 1300°F. Post-irradiation examination of ESH-4 was completed. Visual examination of all elements disclosed no unusual condition. Process tube joints of Zircaloy-2 to Incoloy-800 were successfully fabricated, and testing was initiated. Results to date are good. The SC-8 capsule, containing 72 tensile coupons of various candidate clad materials was irradiated for 1½ cycles in the GETR. The estimated fast neutron dose was 2×10^{20} nvt. Coupons will be tested at room temperature and elevated temperatures. Tensile coupons in the ESH-1.1 assembly were examined using electron microscopy to determine the microstructure at the fracture surface. Incoloy changed from transgranular failure in the unirradiated specimens to intergranular failure of the irradiated specimens. Hastelloy-X and Inconel-600 behaved similarly. All had grain boundary precipitates that were not identified. Corrosion testing with heat transfer was completed for Incoloy-800 (low titanium, aluminum). This alloy behaved differently than commercial Incoloy-800 in that it had a nonuniform surface alloy layer above 1100°F. Testing of Inconel-600 is continuing. Testing of Inconel-625 was initiated. Corrosion tests on Incoloy-800 have indicated that prescaling at lower temperatures (~900°F) significantly effects surface-alloy layer formation at higher temperatures. This can account for the lack of such layer formation on elements of ESH-1.1. Testing was completed on specimens of Fe–Cr–Al–Y alloy and Nb-21Ti-12V-9Cr alloy. Metallographic examination of an ESH-1.1 process tube (type 304 stainless steel) and the BONUS velocity tube (type 348 stainless steel) indicated that neither of these materials had evidence of localized corrosion. Post-irradiation examination of the ESH-4 fuel bundle and pool disassembly proceeded satisfactorily. Two elements stuck during removal from the process tube, and the spacer-orifice unit broke loose. There was no damage to the fuel rods. The MSCA was fully loaded with the fast core and measurements initiated to establish concept technical feasibility. Prior to shutdown of the facility for addition of roof shielding, power distribution, Doppler, and preliminary flooding measurements were obtained. Work was continued on the analysis of results with primary effort devoted to revision of the neutron cross-section files. (auth)

10542 (GNE/Phys/64-10) A FEASIBILITY STUDY OF A HIGH-TEMPERATURE LIQUID-ALUMINUM-COOLED, FLUIDIZED-BED NUCLEAR POWER REACTOR (thesis). Kenneth Robert Hooks (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1964. 140p. (AD-603610). $4.00(OTS).

A feasibility study of a high temperature, liquid-metal-cooled nuclear power reactor depends upon considerations of materials, heat transfer, fluid flow, and nuclear parameters as well as certain design guidelines. The criteria of a coolant outlet temperature of 2000°C and a low pressure core, plus good nuclear and heat transfer properties, led to the choice of liquid aluminum as the coolant. A compatibility study determined that only aluminum mononitride is inert to aluminum at 2000°C, and must be used for constructing the core. Fuel elements of uranium mononitride were chosen on the basis of probable compatibility with the required aluminum nitride cladding. Consideration of the heat transfer effects led to the choice of micron-size coated fuel particles in a cylindrical fluidized bed core. Three methods of determining the parameters of the fluidized bed were used to indicate the best particle size and aluminum flow rate in the core for any desired power level. The nuclear parameters of the system were studied using two-group diffusion theory and an infinitely reflected spherical geometry. The results predict a fast core with a critical mass above ten kilograms, and indicate that the reactor may be made inherently stable by correct design of the core. (auth)

10543 (HW-72432) NPR SECONDARY COOLING SYSTEM SIMULATION STUDY. EQUATIONS AND ANALOG CIRCUITS. F. J. Mollerus, Jr., and W. D. Cameron (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 19, 1962. Contract AT(45-1)-1350. 88p. Dep.(mn); $3.00(cy), 2(mn) OTS.

The NPR secondary cooling system is a complex arrangement of steam generators, dump condensers, pumps, valves, piping and controllers. The complexity of the system and variety of transients, such as reactor startup, shutdown, power setback, and scram, to which the system must respond requires analog simulation for analysis of methods of control and to determine system component performance, adequacy of control, and response during transients. A description is presented of the secondary cooling system and its operation during steaming duty, the development of analog equations and circuits, and instructions for the use of the equations and circuits in simulation of the system. (auth)

10544 (HW-77027) N-REACTOR PRESSURIZER—HIGH-PRESSURE INJECTION PUMP SIMULATION STUDY. PART I. EQUATIONS AND ANALOG CIRCUITS. R. K. Robinson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 16, 1963. Contract AT(45-1)-1350. 85p. Dep.(mn); $3.00(cy), 2(mn) OTS.

The N reactor pressurizer and high pressure injection system combination are required to maintain primary loop pressure and water inventory in a safe, stable, and continuous manner during all reactor transients. These transients range from the relatively mild disturbances of process tube diversion, process tube return, and reactor power level increases and decreases to the very violent transient of a reactor power level scram with or without loss of one electrical power source. The pressurizer and high pressure injection complex include a pressure vessel with heaters and sprays to regulate system pressure, fill and spill valves to regulate the water level in the pressurizer, and high pressure injection pumps which lift injection water above the system pressure. The high pressure injection pumps are also required to supply water to the primary pump seals and a supplemental cold water spray to the pressurizer in the event the normal sprays cannot maintain setpoint. An analog simulation was made to study component performance, the methods of control, the response of the pressurizer and injection system combination, and to determine the adequacy of control. A description is given of the pressurizer and high pressure injection system and its operation, the development of the system equations, and the analog circuits. (auth)

10545 (HW-78428) CONSEQUENCES OF NPR CAP FAILURE. Peter Riggle (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 29, 1963. Contract AT(45-1)-1350. 9p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The consequences of the failure of either a front or rear NPR process tube nozzle cap are studied. The basis for this study is that failure of a nozzle cap might allow the fuel to be ejected from the reactor. Such ejected fuel might receive either mechanical or thermal damage and release significant quantities of fission products in a short time. If the steam release rate were then greater than the combined capacity of the filter and fog spray systems, the confinement vents would open allowing the released fission products to escape into the atmosphere. Calculations indicate that failure of a central zone nozzle cap during full power operation would result in steam release rates within the combined capacity of the fog spray and filter systems. This means that the confinement system should satisfactorily handle this incident, and any release of fission products should be through the confinement filter system. Mechanisms exist for both thermal and mechanical damage to the cladding of any ejected fuel. Although failure of a nozzle cap appears to be very remote, the probability of fission product release within the confinement zone upon nozzle cap failure is appreciable. (auth)

10546 (HW-SA-3683) RADIOACTIVE AIRBORNE POLLUTANTS— EFFECTIVE CONTROL IN A NUCLEAR POWER ECONOMY. L. C. Schwendiman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 19, 1964. Contract AT(45-1)-1350 19p. (CONF-641103-1). Dep.(mn); $1.00(cy), 1(mn) OTS.

From Air Pollution Control Assn. Annual Meeting Northwest Section, Portland, Oreg.

The potential for air pollution from the various steps in the fuel cycle is discussed. Experience in the nuclear field to date is utilized to draw conclusions as to future trends in air pollution problems resulting from the expanding nuclear industry. Two potentials for radioactive contamination of the environment must be investigated in the processing or applications of radioactive materials. The first is the potential for significant releases of airborne radioactive materials in the day-to-day routine operation. The second is the potential for and consequences of an accidental release of airborne contaminants. A conclusion is reached that the proven technology of air pollution control in processing radioactive materials and the anticipated progress from research underway will permit very low release limits for radioactive materials to be realized in routine operations. The licensing and control requirements for guarding against serious releases in accidents will reduce the probability of damage to individuals and property to a point which should not prove a deterrent to the continued growth of nuclear power and extensive applications of radioactive materials. (auth)

10547 (IEA-74) CALCULATION OF THE NEUTRON AND GAMMA-RAY DISTRIBUTION IN THE EBWR RADIAL SHIELD AT 100-MW OPERATION. Wilma Sonia Hehl (Brazil. Instituto de Energia Atômica, Sao Paulo). Nov. 1964. 62p. Dep.(mn).

The equal-volume sphere core, with a radius of 73 cm, was chosen for the study as indicated by calculations for the best core geometry. Shielding in the radial direction, as made up of water, boron, steel, lead, heavy concrete and light concrete, was analyzed. The fast and thermal neutron flux calculations were done by two-group analysis, using a computer for the latter. Determination of the gamma flux from the core, as well as the capture gammas, comprise the rest of the calculations. The procedures followed and the calculations made in connection with the study are explained, and the results are tabulated and plotted. (auth)

10548 (NAA-SR-9213(Vol.I)) 1000-MWE SGR AND PROTOTYPE EVALUATION STUDY. VOLUME I. LARGE SGR DESIGN BASES, ECONOMICS, AND DEVELOPMENT PROGRAM. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 1963. Contract AT(11-1)-Gen-8. 308p. Dep.(mn); $7.00(cy), 5(mn) OTS.

The design bases, economics, conceptual design, and development of a 1000-Mwe sodium graphite reactor are presented. The design bases and development of a prototype 200-Mwe sodium-graphite plant are also described. (T.F.H.)

10549 (NAA-SR-Memo-7429) OMRE 40 MICRON FULL FLOW FILTER. J. Kajor and R. J. Mack (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 31, 1962. Contract AT-11-1-GEN-8. 9p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The installation of a fine mesh filter in the primary system has been analyzed. In the event of filter plugging, only minor modifications are required to protect the reactor system. However, the simultaneous plugging of the filter and loss of main loop pumping capacity (e.g., loss of site power) may result in compromising the ability to remove afterglow heat by means of natural circulation. Consequently, a decay heat loop capable of adequately protecting the core irrespective of reactor operating conditions or status is considered necessary. The design of this loop is presented in NAA-SR-TDR-7430. (auth)

10550 (NAA-SR-Memo-10593) A SUMMARY OF SRE SODIUM SYSTEMS EXPOSURE HISTORY. F. H. Dunbar (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 22, 1964. Contract AT-11-1-GEN-8. 23p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Since the SRE went critical in March of 1957, 64,250 calendar hours have elapsed. During this interval, the reactor was at a power ≥15 Mw(t) for 5,256 hours, ≥10 Mw(t) for 10,144 hours, and ≥5 Mw(t) for 14,992 hours, critical (0.01% or more of full power) for 27,300 hours, and down for 36,950 hours. In July of 1959 several fuel elements and moderator cans were damaged because of high fuel channel temperatures caused by fouling. The recovery took about 12 months and included the replacement of 16 moderator cans and the loading of the second SRE core (Core II). The initial criticality of Core II was September 9, 1960. Since April of 1957, there have been about 44,000 cumulative hours of sodium flow in the primary systems (core, main primary, and auxiliary primary) with an approximate range of 285°F to 1030°F. Since May of 1958, there have been about 25,000 cumulative hours of sodium flow in the main secondary system, with an approximate range of 300°F to 1000°F. A graphical presentation of the SRE operating history is given. (auth)

10551 (NYO-3316-1) A STUDY OF DESALTING PLANTS (15 TO 150 mgd) AND NUCLEAR POWER PLANTS (200 TO 1500 MWt) FOR COMBINED WATER AND POWER PRODUCTION. Final Report. (Catalytic Construction Co., Philadelphia and Nuclear Utility Services, Inc., Washington, D. C.). Sept. 1964. Contracts AT(30-1)-3316 and 14-01-0001-367. 358p. Dep.; $3.50 (OTS).

An analysis is carried out of the various factors affecting the economics of sea-water desalination by a multi-stage flash-evaporation plant, operated in conjunction with an electricity-generating station. Four concepts are considered as power sources for the combined facility, namely low- and high-temperature nuclear reactors and low- and high-temperature natural-gas boilers. Plant sizes of 200 to 1500 Mwt are considered. The economics of the station are compared with the economics of separately operated plants of the same water and electric outputs. (T.F.H.)

10552 (ORNL-3686) A COMPARATIVE EVALUATION OF ADVANCED CONVERTERS. M. W. Rosenthal, R. E. Adams, L. L. Bennett, et al. (Oak Ridge National Lab., Tenn.). Jan. 1965. Contract W-7405-eng-26. 257p. Dep.; $6.00(OTS).

Advanced converters possess desirable attributes: good uranium utilization; use of thorium; low fuel cycle cost; high efficiency; long fuel life; high plutonium production (for providing fast-reactor inventories); and others. A study was initiated to analyze the economic value of these features and to provide information on the relative merits of various advanced converters. A design for a 1000-Mw(e) pressurized-water reactor was included in the evaluation in order to provide a comparison with advanced converters. (auth)

10553 (ORNL-3708) MOLTEN-SALT REACTOR PROGRAM SEMIANNUAL PROGRESS REPORT FOR PERIOD ENDING JULY 31, 1964. (Oak Ridge National Lab., Tenn.). Nov. 1964. Contract W-7405-eng-26. 397p. Dep.; $7.04 (cy), 9(mn) OTS.

Separate abstracts have been prepared for the 17 reactions of the report. (N.W.R.)

For abstracts of individual sections see: 10554, 10555, 10556, 10557, 10558, 10559, 10560, 10561, 10562, 10563, 10564, 10565, 10566, 10567, 10568, 10569, and 10570.

10554 (ORNL-3708(p.1-3)) THE PLACE OF MOLTEN-SALT REACTORS IN THE AEC PROGRAM. E. E. Sinclair (Oak Ridge National Lab., Tenn.).

10555 (ORNL-3708(p.3-21)) MOLTEN-SALT POWER REACTORS AND THE ROLE OF THE MSRE IN THEIR DEVELOPMENT. R. B. Briggs (Oak Ridge National Lab., Tenn.).

Realization of a breeder system that makes full use of the potential energy in thorium to produce cheap electricity is the primary mission of MSRE. Development, economic aspects, performance estimates, and technological aspects are discussed and evaluated. (N.W.R.)

10556 (ORNL-3708(p.22-82)) MSRE DESIGN AND CONSTRUCTION. W. B. McDonald (Oak Ridge National Lab., Tenn.).

A general description of the design of the MSRE systems, pointing out the most salient features and presenting data of general interest, is given. The major features of the reactor and facility construction are described. (N.W.R.)

10557 (ORNL-3708(p.83-114)) NUCLEAR CHARACTERISTICS OF THE MSRE. R. J. Engel (Oak Ridge National Lab., Tenn.).

The basic concept of the MSRE is a cylindrical vessel containing a graphite matrix for neutron moderation through which a molten-salt fuel is circulated. To provide a logical basis for the core design, several preliminary studies were made to establish the dependence of a limited number of nuclear properties on important core parameters. Three combinations of the components of the fuel mixture were considered in these calculations. Information is included on control rods, core temperature, fission product poisoning, neutron sources, kinetics, and biological shielding. (N.W.R.)

10558 (ORNL-3708(p.115-46)) INSTRUMENTATION AND CONTROL OF THE MSRE. J. R. Tallackson (Oak Ridge National Lab., Tenn.).

The MSRE is well equipped with instruments to meet both operational and experimental requirements. The instrumentation and control system is to provide data to verify the designed performance, information for reactor experiments, and safe orderly operation of the reactor system. Information is included on temperature control, process measurements, rod drives, safety system, reactor control system, load control, circuit jumping, process radiation monitoring, nuclear instruments, health physics monitoring, beryllium monitoring, and data logger-computer systems. (N.W.R.)

10559 (ORNL-3708(p.147-67)) PUMP DEVELOPMENT. A. G. Grindell and P. G. Smith (Oak Ridge National Lab., Tenn.).

The work done on producing the high-temperature salt pumps used in the MSRE and the present status of that pump technology are reviewed. Distinguishing features of the pumps, noteworthy problems resolved during design and testing, and a general description are summarized. Two of these pumps are required to circulate the salts in the MSRE, one in the fuel-salt and one in the coolant-salt circuits. Each pump must provide for the thermal expansion of the salt in its circuit and for the sampling of that salt. The fuel-salt pump must provide for the removal of xenon-135 from the fuel salt and for the addition of fuel concentrate to the fuel salt as burnup progresses. The fuel-salt pump, a hermetic sump-type centrifugal pump, consists of three main components: the pump tank, the rotary assembly, and the drive motor. These are supplemented with associated lubrication and purge-gas systems and instrumentation and controls. (N.W.R.)

10560 (ORNL-3708(p.167-90)) COMPONENT DEVELOPMENT IN SUPPORT OF THE MSRE. Dunlap Scott, Jr. (Oak Ridge National Lab., Tenn.).

The effect of the development work in establishing the reliability of the MSRE components is discussed. Prototypes of critical components were operated out-of-pile under conditions resembling those of the reactor. The performance of the components tested has exceeded the requirements for the MSRE. The components needing maintenance were made easily replaceable. The components and systems were shown to be compatible when operated as a loop. Information is included on core hydraulics and heat transfer, heat exchanger testing, vessel and line heater development, freeze flanges and valves, control rod system, cover-gas system, sampler-enricher, and engineering test loop. (N.W.R.)

10561 (ORNL-3708(p.190-200)) REMOTE MAINTENANCE OF THE MSRE. Robert Blumberg (Oak Ridge National Lab., Tenn.).

The MSRE from a maintenance viewpoint is a collection of replaceable parts joined by disconnects. Small parts will be maintained by long-handled tools inserted through a portable shield, and large parts will be prepared for removal with long-handled tools and then removed by remote equipment. There are three general divisions that comprise the equipment to be used; the shielding, the long-handled tools, and the remote equipment. (N.W.R.)

10562 (ORNL-3708(p.201-5)) FUEL PROCESSING FACILITY. R. B. Lindauer (Oak Ridge National Lab., Tenn.).

The fuel processing facility for the MSRE is described. The facility has two functions. The first is to remove any oxide accumulation in the molten salt by sparging the salt with a mixture of hydrogen and hydrogen fluoride. The second is to recover uranium from the molten salt by sparging with fluorine and volatilizing the uranium as uranium hexafluoride. This second function should not be required until the program using the 30%-enriched fuel ends. At that time, both the flush and fuel salts will be fluorinated to remove the uranium of low enrichment. For the next phase of the program, 93%-enrichment uranium will be added to the fuel. The flowsheet and equipment are described. (N.W.R.)

10563 (ORNL-3708(p.205-13)) PLANS FOR OPERATION OF THE MSRE. P. N. Haubenreich (Oak Ridge National Lab., Tenn.).

The tests and experiments are designed to be penetrating and thorough, so that, when the experiment is concluded, not only will reliable operation and reasonable maintenance have been demonstrated, but there will be as many conclusive answers as possible to the important questions pertaining to the practicability of molten-salt reactors of this general type. The testing and experimental operation of the MSRE are subdivided into the following phases: precritical testing, initial critical measurements, low-power measurements, and reactor capability investigations. (N.W.R.)

10564 (ORNL-3708(p.214-51)) CHEMICAL BASIS FOR MOLTEN-SALT REACTORS. W. R. Grimes (Oak Ridge National Lab., Tenn.).

The thermodynamic behavior of molten-salt systems for use in nuclear reactors, with special emphasis on those for use in MSRE, is surveyed. Molten-salt mixtures are versatile; they can serve as fuels, blankets, and coolants. With them a family of reactors, operating at low pressure and at usefully high temperature, can be provided. (N.W.R.)

10565 (ORNL-3708(p.252-87)) EFFECTS OF RADIATION ON THE COMPATIBILITY OF MSRE MATERIALS. F. F. Blankenship (Oak Ridge National Lab., Tenn.).

Postirradiation examination of the capsules from in-pile tests of MSRE fuel-graphite-metal compatibility continues to furnish evidence of evolution of fluorine and CF_4, graphite damage, and other potentially unfavorable phenomena. All cases of unusual behavior seem to be consequences of fluorine generation at low temperatures under conditions which will not normally be obtained in MSRE. The metals involved are INOR-8 and molybdenum. (N.W.R.)

10566 (ORNL-3708(p.288-303)) PREPARATION OF MSRE FUEL, COOLANT, AND FLUSH SALTS. J. H. Shaffer (Oak Ridge National Lab., Tenn.).

The initial operation of the MSRE will utilize about 26,560 lb of fused fluorides as fuel, coolant, and flush salt mixtures. The reactor fuel mixture will have the composition $LiF-BeF_2-ZrF_4-UF_4$ (65.0–29.1–5.0–0.9 mole % respectively). Fissionable uranium-235 will comprise about one-third of the uranium inventory. An initial loading of 11,260 lb of fuel salt mixture will be required for a desired fill volume of 73 ft^3 in the reactor assembly. The coolant and flush salt mixtures will be chemically identical and will have the composition $LiF-BeF_2$ (66-34 mole %). Approximately 15,300 lb of this mixture is needed for a coolant salt volume of 42 ft^3 and a flush salt volume equivalent to that of the fuel mixture. Techniques for preparing the fused fluoride mixtures are described. (N.W.R.)

10567 (ORNL-3708(p.304-20)) FUTURE CHEMICAL DEVELOPMENT. H. F. McDuffie (Oak Ridge National Lab., Tenn.).

A number of chemical developments which permit a tentative look ahead to the extension of the molten-salt concept to economical operation and to a broader range of reactors is summarized. Reactors closely related to the MSRE are discussed first, with other types of thermal and fast reactors discussed later. (N.W.R.)

10568 (ORNL-3708(p.320-30)) ANALYTICAL CHEMISTRY FOR THE MOLTEN-SALT REACTOR. J. C. White (Oak Ridge National Lab., Tenn.).

Development and evaluation of the methods required for the analysis of the MSRE fuel and related problems and investigation of the feasibility of various techniques for in-line monitoring of the fuel are summarized. (N.W.R.)

10569 (ORNL-3708(p.330-72)) METALLURGICAL DEVELOPMENTS. A. Taboada (Oak Ridge National Lab., Tenn.).

The metallurgical developments in support of the MSRE were limited to establishing the compatibility of INOR-8 in a molten salt-graphite system at MSRE conditions and to generating the metallurgical information necessary to design, fabricate, and operate the reactor. Included in this work was the preparation of standards for materials procurement and for the fabrication of components. A description of these metallurgical achievements is presented. Thermal- and forced-convection loop tests, operating for periods from one to two years, have demonstrated the validity of the corrosion model and the corrosion resistance of the alloy. Problems of melting, casting, forming, and joining were investigated, and it is noted the INOR-8 offers no unusual difficulties in any of these categories. The physical and mechanical properties of the alloy were measured, and sufficient data are available to establish design criteria. Irradiation effects are being studied and large reactor components were made from this alloy. It is therefore concluded that INOR-8 successfully meets the requirements of a construction material for the MSRE. (N.W.R.)

10570 (ORNL-3708(p.373-89)) MSRE GRAPHITE. W. H. Cook (Oak Ridge National Lab., Tenn.).

The nuclear grade CGB graphite for the MSRE is basically an extruded petroleum coke bonded with coal tar pitch heated to 2800°C. Low permeation is obtained through a series of impregnations and heat treatments. The final heat treatments were at 2800°C or higher. Properties of the produced bars are given and evaluated. Its matrix is not permeated by molten salts under conditions more severe than those expected in the MSRE. It exceeded all the requirements specified for the MSRE except that it had longitudinal cracks that did not have any adverse effects on the operation of the MSRE. The shrinkage of the graphite at 350 to 475°C under exposures between 0.60×10^{20} to 1.40×10^{20} nvt ($E > 2.9$ Mev) indicated that this should not create any important adverse effects on the operation of the MSRE. (N.W.R.)

10571 (SRO-111) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, DECEMBER 1964. (Savannah River Operations Office, AEC). 5p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Development of fog-cooled reactors, heavy water organic-cooled reactors, fuel elements, reactor materials, and electron beam welding is summarized. Information is included on: CANDU Reactor fuel element testing, HWCTR operation and shutdown, CVTR operation, ductility of Zircaloy-2, and heat transfer and fluid flow studies. (N.W.R.)

10572 (TID-21406) HALLAM NUCLEAR POWER FACILITY MONTHLY OPERATING REPORT NO. 26, SEPTEMBER 1964. (Consumers Public Power District, Lincoln, Neb.). Contract AT(11-1)-513. 73p. Dep.(mn); $2.00(cy), 1(mn) OTS.

At the beginning of the period the reactor was carrying the entire Sheldon Station load. On September 2, a critical power breaker failure scrammed the reactor, which in turn resulted in a short turbine outage. The reactor was restarted on September 2 and carried the station load until September 10. Due to the failure of moderator element M-51 on the evening of September 9 the conventional boiler was put in service in parallel with the reactor. The conventional boiler tripped and the reactor scrammed on September 10, due to a temporary loss of instrument air in the conventional portion of the plant. The boiler was refired and the turbine was back on the line in eight minutes. The reactor was restarted and operated in parallel with the boiler until the evening of September 11 when the boiler was placed on hot standby. The reactor carried the station load until September 15 when the boiler was returned to service in parallel with the reactor. On September 16 the boiler was placed on cold standby and the reactor carried the load until September 22 when an electrical power failure off-site caused it to scram. The reactor was restarted and carried the station load until September 27. The reactor was shut down to run rod drop time tests in connection with the failure of moderator elements M-42 and M-67. Information is also included on plant performance, testing, radiation control, maintenance, and modifications. (N. W. R.)

10573 (TID-21407) 237-MW KRB NUCLEAR POWER PLANT QUARTERLY REPORT. (Kernkraftwerk RWE-Bayernwerk G.m.b.H., Gundremmingen, Germany). 1964. 63p. (EUR/C/4630/64e). Dep.(mn); $2.00(cy), 2(mn) OTS.

Pressure and leak-testing of the containment shell was started in January. When the test pressure reached 4 atm g (the envisaged maximum pressure being 5.4 atm g), the test had to be stopped due to inadmissibly high stressing at several points on the shell. A series of incipient cracks was found at penetrations and at points where supports were welded. Construction work was resumed after completion of the pressure test. Fabrication of the plant components is proceeding according to plan without any appreciable deviations from schedule. In the US the production of fuel, parts of the control-rod system, and steam driers, was started. (auth)

10574 (WCAP-2565) A LINEAR TECHNIQUE FOR THE STABILITY ANALYSIS OF NUCLEAR POWER PLANTS. R. F. Barry (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Feb. 1964. 82p. Dep. (mn); $3.00(cy), 2(mn) OTS.

A study is made that is concerned with the moderator coefficient, and can be safely generalized in judging the linearized analysis technique. The results of the linearized analysis largely coincide with the analog results when the system is subjected to large load changes. For somewhat smaller load changes, the agreement is poor. The inference is that the low-pass linear representation of the dead band relay is inadequate when the relay input is of the order of the relay dead band. When the relay input signal is larger, the low pass representation is very adequate. A second point which must be considered a drawback is that the linearized analysis was developed for a particular mathematical model. If the model were changed, perhaps to include distinct moderators and coolants, the development would have to be almost entirely redone. Without discounting the poor agreement between analog results and analytic results for smaller load changes the linearized analysis does satisfy these goals: it gives an estimate of the sensitivity of system stability to changes in system parameters; and it can be performed by hand or for very little cost on a digital computer. (auth)

10575 (WL-TDR-64-25) MILITARY NUCLEAR POWER PLANTS. John D. Belson (Air Force Weapons Lab., Kirtland and AFB, N. Mex.). June 1964. 247p. (AD-602678) $6.00(OTS).

Air Force, Army and AEC interrelationships within the nuclear power program are discussed along with development and procurement procedures. Selection standards and training requirements for nuclear power plant operators and officer-in-charge are presented. Cost curves have been included to aid in estimating the capital and operating costs of nuclear and conventional power plants and the breakeven fuel-oil prices for nuclear versus fossil-fuel plants. The capabilities of nuclear power within existing technology are evaluated and possible areas of application discussed. (auth)

10576 PLANNING OF THE HELIUM CIRCULATING SYSTEM OF A HIGH-TEMPERATURE REACTOR. F. Helfrich, J. Schoening, and W. Fluegger (Brown Boveri/ Krupp Reaktorbau GmbH, Mannheim, Ger.). Atomwirtschaft, 9: 620-5(Dec. 1964). (In German)

The development of high-temperature reactors poses numerous problems from the planning through the development and testing of individual components to the assembly and possible decontamination of individual parts for the purpose of extension and replacement. The safety and economics of the installation depend on their solution. Because of the lack of sufficient operating experience excessive expenditure must often be incurred particularly in the case of the construction of the first installation. Helium is preferred as the cooling gas at the present state of technology. In addition to the main circulatory system a series of subsidiary systems is necessary. Construction and safety arrangements are appropriate to the individual components of the circulatory systems according to the activity, impurities, and temperature. Mostly these cannot be based upon conventional constructions but require special designs which must be developed and tested. Most of the areas of difficulty have as their main problem the entrance of radioactivity into the circulatory system. Special consideration is given to the gas requirements and gas purification. The safety circuits constitute an important part of the safety measures. The use of operationally safe components as well as selective circuits, e.g., the "2 out of 3" circuit has proved successful in making them insensitive to failure. On grounds of safety special significance attaches further to materials and their processing. Unusually high quality requirements must be placed on them which stem from the severe mechanical, chemical and nuclear-physical demands. From such considerations emerge stipulations regarding the work, means of construction, and assembly which are unusual as compared with conventional technology. They are described using as example the He circulatory system of the AVR high-temperature reactor developed by BBC/Krupp and now in process of erection at the site of the Jülich Nuclear Research Center. (auth)

10577 PROBLEMS OF THERMAL INSULATION IN NUCLEAR POWER STATIONS. R. Hempel (Rheinhold & Mahla GmbH, Mannheim, Ger.). Atomwirtschaft, 9: 626-8(Dec. 1964). (In German)

The experience that was gained with the erection of the Karlsruhe FR 2 reactor is helping to clear up the problems in insulation techniques. At the same time the construction showed that in the erection of nuclear energy installations a significantly wider range of industry is involved than merely those firms developing and building the reactors. Safety and economic requirements demand numerous specific measures of thermal conservation. The choice of materials must be reconciled with the special nuclear-physical interests and, in addition, due regard must be paid to the action of radiation on the materials. The neutron economy demands avoidance of parts which have a high neutron absorption cross-section. Practice has shown that, as far as possible, mineral fibrous material or granular substances should be used. An important part of the work in question was the construction of the gas-tight hull of the FR 2 reactor. Mineral wool, felt plates, and cork plates expanded by a special process were used as insulating materials. The quality of the insulation is, in the case of power reactors or atomic power stations, an important factor determining the constancy of the temperature levels on both the primary and secondary sides. By optimizing the lay-out of the insulation on the secondary side the desired steam characteristics can be held as constant as possible and disturbances on the primary side also eliminated. The main difficulties in the insulation and assembly of protective hulls for a given installation arise from the necessity for numerous channels and openings for control rods, measuring instruments and cooling connections. (auth)

10578 ESTIMATION OF RADIOLOGICAL EFFECTS OF DISTURBANCES OF GREAT WATER-COOLED POWER REACTORS. H. Karwat (Technische Hochschule, Munich). Atompraxis, 10: 526-32(Dec. 1964). (In German)

Calculation methods used to determine the release of fission products from a core after a loss-of-coolant accident are given. Relationships for fission product release rates from the containment to the surrounding atmosphere are presented with regard to the effects of wash-out and condensation of fission products within the containment and the influence of the leak rate of the containment. An example shows how wash-out within the containment and temperature for the release of iodine from the fuel influence the contamination in the environment of a reactor station. While the release temperature mainly influences the short-time values of the contamination in the surroundings up to 1 or 2 hours washout and condensation of fission products within the containment give a strong variation of the long-time values of the contamination outside the reactor station. The importance of low leak rates of the containment is discussed. (auth)

10579 THE TECHNICO-ECONOMIC SITUATION OF NUCLEAR POWER PLANTS WHICH APPEARED AT THE III GENEVA CONFERENCE. Comit. Nazl. Energia Nucl., Notiziario, 10: No. 10, 33-53(Oct. 1964). (In Italian)

The technical and economic aspects of nuclear power plants as reported at the Third Geneva Conference are summarized. Only those reactor types that appeared to be of industrial and economic interest at present were considered. Gas-cooled, light-water-cooled, sodium-cooled, heavy-water-cooled, and fast reactors are discussed. (J.S.R.)

10580 PERFORMANCE OF BRITISH NUCLEAR POWER-STATIONS. Engineer, 218: 444-5(Sept. 18, 1964).

Operating experience at Bradwell and Berkeley, the first two nuclear power stations of the Central Electricity Generating Board, is described. Performances of the fuel elements, the failed cartridge detection system, the on-load refuelling system, and the start-up and load-following procedures are reviewed. Legal operational limits in fuel-element and graphite temperature and their maintenance are discussed. The two reactor incidents and the present performance are surveyed. (M.J.T.)

10581 IN-PILE BURNOUT PROTECTION DEMONSTRATED AT HBWR. H. P. Olson (OECD Halden Reactor Project, Halden, Norway). Euro Nucl., 1: 225-8(Dec. 1964).

An in-pile burnout protection device for the Halden Boiling Reactor is described. It consists of a standard thermocouple mounted in the top end of one of the seven fuel rods in the fourth instrumented fuel assembly. Functional testing of the burnout protection thermocouple consisted of raising the fuel assembly power until the thermocouple indicated a massive increase in cladding temperature. Slow scrams were initiated during the first few temperature transients and during the subsequent transients the heat flux was held constant. On the latter occasions, spontaneous recovery of normal cooling, as well as stable operation with film boiling, was observed. (M.C.G.)

10582 ECONOMY OF NUCLEAR POWER STATIONS. REPORT OF THE ECONOMIC SUBCOMMITTEE. FAPIG (Tokyo), No. 31, 18-25(Apr. 1964). (In Japanese)

The economic aspects of nuclear power stations is discussed, using data from the construction of the Tokai power station of Japan Atomic Power Company. Taxation, insurance, and finances for construction, operation, and maintenance are considered. The various taxes included were calculated. The insurance is of two kinds, i.e., construction and maintenance. Sources of finance are discussed. The systems in Japan for buying, using, and processing nuclear fuels and some examples of calculation of fuel costs are given. Construction costs and power costs are included for gas-cooled reactors, heavy-water-moderated and -cooled reactors, and light-water-cooled reactors. (NSA of Japan)

10583 OUTLINE OF THE CONSTRUCTION OF THE TOKAI POWER STATION. Tatsuo Yasuda (Fuji Electric Mfg. Co., Ltd., Japan). FAPIG (Tokyo), No. 31, 26-34 (Apr. 1964). (In Japanese)

Construction of the Tokai power station for the period from June 1962 to January 1964 is described. Work on the spherical shell, the steam generator, and other components is discussed. The shielding, steam generator building, service building, fuel handling building, gas ducts, cooling pond, radioactive effluent treatment plant, pressure vessel, turbine generator, electric facilities, CO_2 gas storage, BCD pipe, welding electrodes, steam generator, gas circulator, and main gas ducts are under contract for construction. (NSA of Japan)

10584 WELDING OF THE PRESSURE VESSEL AND THE ACCURACIES OBTAINED. Kazukiyo Okano (Fuji Electric Mfg. Co., Ltd., Japan). FAPIG (Tokyo), No. 31, 35-8(Apr. 1964). (In Japanese)

The weldings successfully done for construction of the spherical pressure vessel of the Tokai power station are reported. The over-all structure of the vessel consists of a top cap, four belts, a skirt, and a bottom cap, which were welded together to make up a sphere. These sections were prefabricated separately by welding plates together. The plates were prepared by hot-forging, gas cutting, machining, grinding, etc. The prepared plates were assembled by means of restricting plates welded to one of the plate elements. To obtain the required accuracy, the dimensions of the belt body sections were controlled during the last butt welding. The prefabricated sections were transferred and assembled in the reactor building. In assembling the welded restricting plates the tack welding technique was employed. After the assembly was complete, all the circumferential zones to be welded were preheated by burners on the outside. Then simultaneous and consecutive welding by about twenty workers was carried out on the inside and then on the outside. (NSA of Japan)

10585 STATUS OF THE USED FUEL IN THE ATOMIC POWER GENERATION. Minoru Takahashi (Central Research Inst. of Electric Power Industry, Tokyo). Genshiryoku Hatsuden, 8: 10-15(Mar. 1964). (In Japanese)

The sending of the spent fuel to other countries for reprocessing involves some difficulties, including transport, cost, etc. Reprocessing in Japan is, therefore, recommended and discussed. Ways in which to use the plutonium produced in power reactors are considered. Two ways are suggested: storage until the fast reactors to use it are constructed and use in thermal reactors immediately after it is produced. (NSA of Japan)

10586 DEVELOPMENT OF JAPAN-MADE POWER REACTORS AND THE NECESSARY CONDITIONS. Eiichi Takeda (Tokyo Inst. of Tech.) and Eizo Sugimoto. Genshiryoku Kogyo, 10: No. 6, 6-32(June 1964). (In Japanese)

The significance of the development of Japanese power reactors is discussed. Various types of power reactors were investigated for development in Japan and the heavy-water-type was selected as the most suitable. Various types of heavy-water-moderated reactors using different coolants are compared. Construction design of the Japanese power reactor is described. It is a heavy-water reactor using natural or low-enriched uranium. The thermal design of the Japanese power reactor and the core design are described. (NSA of Japan)

10587 RADIATION CONTROL AT THE TOKAI POWER STATION OF THE JAPAN ATOMIC POWER COMPANY. Tetsuro Itakura and Yoshiyuki Nishikawa (Japan Atomic Power Co.). Genshiryoku Kogyo, 10: No. 6, 67-70(June 1964). (In Japanese)

Radiation protection methods planned for the personnel and the public in the vicinity are described. The radiation sources involved are divided in two types: those occurring in the reactor and other radioactive installations, and those discharged from the reactor and other installations, namely, liquid and gaseous radioactive wastes, etc. The first type is not as dangerous as the latter, since these installations are adequately shielded. It is with the second type of sources that careful radiation control must be carried out. It was concluded that the atmosphere in and around the site of the power station, and the radioactive wastes must be constantly monitored, and appropriate measures taken when necessary. (NSA of Japan)

10588 THE EXPERIMENTAL LOOP OF THE KS-150 REACTOR. Jan Hanzlik, František Klik, Václav Patrovský, Václav Velechovský, and Josef Zběhlík. Jaderna Energie, 10: 394-7(1964). (In Czech.)

The design of a gas-cooled experimental loop is described. Temporarily the loop is to be built in one peripheral fuel channel in the reactor of the first Czechoslovak ion nuclear power station (KS-150). Influence of this loop on operation of the power station and improvements of the design, which may change the need for emergency scram of the reactor, are discussed. The attainable loop parameters and experimental possibilities are reported. (auth)

10589 ELECTRIC ANALOG MODEL FOR REPRODUCTION OF THE TEMPERATURE FIELD AND HEAT FLUX IN FUEL ELEMENTS OF THE LUCENS REACTOR. S. Aftalion (Gebr. Sulzer AG, Winterthur, Switzerland). Neue Tech., 6: 318-21(Dec. 1964). (In German)

The thermal behavior of fuel elements for the Lucens reactor was simulated by electric analogy. The canned uranium bar was represented by a resistance network, the graphite block by conducting paper. (auth)

10590 MEASUREMENT OF HEAT TRANSFER AND PRESSURE DROP ON RODS WITH LONGITUDINAL FINS. R. Naegelin, N. Cadelli, and G. Ciszewski (Therm-Atom AG, Winterthur, Switzerland). Neue Tech., 6: 321-31(Dec. 1964). (In German)

With regard to the design of the fuel element for the Lucens reactor heat transfer and pressure drop of rods bearing longitudinal fins in a cylindrical channel were measured. Results for six different fin geometries and methods applied for evaluation are given. In comparison with the relations for the round tube, the observed heat transfer coefficients were somewhat smaller while the pressure drops were rather larger. (auth)

10591 PLUTONIUM-FUELED THERMAL REACTORS WITH HIGH CONVERSION RATIOS. G. Srikantiah and J. Chernick (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 21: 165-78(Feb. 1965). (BNL-7949)

The breeding potential of thermal reactors fueled by plutonium is evaluated on the basis of present nuclear cross section data. It is shown that it is possible to obtain initial conversion ratios in excess of unity in highly thermal D_2O-moderated systems. Because of the low thermal value of η_{49} and its decrease with spectrum hardening, it becomes necessary to keep the moderator at low temperatures and also to utilize the fast-fission effect in ^{238}U to the maximum extent in order to achieve high conversion ratios. Based on these results a conceptual design of a plutonium-fueled D_2O-moderated reactor is developed. Large diameter, clustered-rod fuel elements in pressure tubes are considered. Using this type of fuel element it is possible to keep the moderator at a low temperature, thereby minimizing the hardening of the spectrum, and also to obtain a large fast-fission effect in ^{238}U. This type of fuel element also permits the use of different coolants such as steam or gas in addition to pressurized D_2O. Although initial conversion ratios slightly above 1.0 are possible, true breeding in dirty, plutonium-fueled, thermal reactors is not claimed. The specific power obtainable varies from 0.8 to 5 Mw/kg of Pu depending on the size of the fuel cluster and on the coolant used. (auth)

10592 THE CONTAINER OF THE EL-4 REACTOR NEARS COMPLETION. R. Gibrat. Rivoluzione Ind., No. 140, 28-30(Sept. 1964). (In Italian)

The economic and technical advantages of the use of pre-stressed concrete in construction of the container of the EL-4 Reactor are briefly reviewed. The design and construction of the floor and ceiling of the container are discussed. (J.S.R.)

10593 DESIGN PROBLEMS IN REACTOR CONSTRUCTION. A. Kuenzli. Sulzer Tech. Rev. (Switz.), 46: 66-70 (1964).

Some of the requirements that have to be met by nuclear reactor design are described. Factors are discussed, which dictate the design of the reactor and its associated plant and equipment. Details are outlined of the problems that had to be solved in design of the pressure-tube connection head and the pressure tubes for the Lucens experimental nuclear power station. (auth)

10594 PARAMETERS FOR DOUBLE-CYCLE POWER PLANTS WITH WATER COOLANT. L. S. Sterman, Kh. Shtekler, and V. F. Zhidkikh (Moscow Inst. of Power Engineering). Teploenergetika, No. 12, 56-61(1964). (In Russian)

A method is given for efficient selection of parameters for double-cycle nuclear power plants with water cooling systems. Economic aspects of the plant were analyzed. (R.V.J.)

10595 ATOMNAYA ENEGIYA V NARODNOM KHOZYAISTVE (EKONOMIKA I OPYT PRIMENENIYA). (Atomic Power in the National Economy (Economics and Practical Application)). V. I. Postnikov and I. M. Razumov. Moscow, Izdatel'stvo "Ekonomika," 1964. 176p.

Data are given on the economical aspects of atomic power plants and on the application of radioisotopes in industry. Radioisotope technology in automation and control operations, defect determinations, and other operations, in industry are discussed. (R.V.J.)

10596 POWER REACTORS OF "PRACTICAL VALUE." Report of the Ad Hoc Committee on Practical Value. (Atomic Industrial Forum, Inc., New York). Sept. 1964. 41p. $10.00.

A discussion is presented of the meaning and consequences of a finding of practical value with respect to power reactor types and of the distinction between commercial and developmental reactor licenses as defined by the Atomic Energy Act of 1954. It is recommended that the Act should be amended to provide for a single system of facility licensing applicable to developmental and proven types of reactor facilities and to eliminate the concept of a finding of practical value. (H.D.R.)

10597 PROCESS DEVELOPMENT OF URANIUM CARBIDE FUEL ELEMENTS FOR LARGE SODIUM GRAPHITE REACTORS. D. K. Magnus (Atomics International, Canoga Park, Calif.). 9p. (CONF-446-73)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

The development and scale-up of processes for fabrication of full-scale UC fuel elements for sodium graphite reactors are described. The processes were demonstrated during a pilot production run of 20 elements and a cost summary based on this fabrication is tabulated. A cost projection for a 500 kg/week fuel-fabrication plant indicates a base cost of $74.91/kg of contained uranium. (H.D.R.)

10598 SOME ASPECTS OF THE DRAGON HIGH TEMPERATURE GAS COOLED REACTOR EXPERIMENT. A. N. Dickson (Atomic Energy Establishment, Winfrith, Dorset, Eng.). 13p. (CONF-446-75)

From American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964.

A brief description is presented of the Dragon reactor design and operation. Problems associated with some of the systems are discussed and areas are outlined in which valuable experience in high temperature reactor operation is anticipated. (H.D.R.)

10599 SUPPORTING INDUSTRIAL COMPLEXES OF NUCLEAR POWER. Oliver Townsend (State of New York Atomic Research and Development Authority, New York). 15p. (CONF-714-2)

From Conference on Nuclear Education in the New Era of Nuclear Power, Gatlinburg, Tenn., Aug. 1964.

Predictions of the growth of the nuclear electric generating capacity in the United States are reviewed along with estimates of the industrial complexes necessary to support the increasing number of nuclear power plants. The role of Federal and state governments and private industry in supporting and fostering the transformation to nuclear power is discussed. (H.D.R.)

10600 UNDERWATER REPAIRS INSIDE IRRADIATED REACTOR VESSEL. E. L. Murri (Phillips Petroleum Co., Idaho Falls, Idaho) and G. S. Keeley. 19p. (CONF-642-13)

From Health Physics Society, Cincinnati, June 1964.

The utilization of water shielding for modifications inside the Big Rock Point reactor vessel was undertaken after an evaluation of the difficulties involved in shielding the irradiated vessel walls and nonremovable reactor internals by other methods. The work was successfully completed using conventional shallow diving apparatus at considerable savings in time, cost, radiation exposure, and safety hazard over more conventional methods. It is suggested that diving be considered in similar cases and that the feasibility of direct underwater maintenance be considered in the design of nuclear facilities. (H.D.R.)

10601 STEAM GENERATING NUCLEAR REACTOR SYSTEMS. Frank Geoffrey Johnson and Geoffrey Vincent Windle (to United Kingdom Atomic Energy Authority). British Patent 972,901. Oct. 21, 1964. Filed Mar. 8, 1963.

A containment and pressure-relief system for steam-generating nuclear reactors to prevent release of contaminants to the atmosphere in the event of rupture of the primary reactor vessel is described. The principal features are a first containment vessel surrounding the reactor and a second containment vessel surrounding and enclosing the first. The two vessels are connected by pressure-sensitive non-return relief means through a pool of water situated between the containment vessels. The second containment vessel is vented to the atmosphere through pressure-relief valves. This arrangement is intended to condense a large proportion of the steam released in the event of reactor rupture and to trap solid radioactive particles in the water pool. (A.G.W.)

Production Reactors

10602 (HW-81172) CONTROL SYSTEM SIMULATION NOMENCLATURE CONSIDERATIONS. C. D. Swanson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 4, 1964. Contract AT(45-1)-1350. 9p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A uniform method is provided for labelling control systems used in the N-reactor simulation studies. It may also prove helpful for other system simulations. The need for such a method arises because of the large number of signal types and ranges used in industrial control systems. The basis of the method is the use of normalized scales for all control and associated measurement devices. Each input and output signal is expressed as a percentage of its full scale, or limiting, value. Similar calculations for valve openings, controller input and output ranges, etc., simplify control loop gain calculations. (auth)

10603 (HW-81413) THE EFFECT OF DEIONIZED WATER ON REACTOR EFFLUENT ACTIVITIES. PART II. ZIRCONIUM AND ALUMINUM-CLAD FUEL. W. B. Silker and C. W. Thomas (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 1964. Contract AT(45-1)-1350. 15p. Dep.; $1.00(OTS).

The location of specific radionuclide production in single pass reactor process tubes cooled with deionized water was determined using combinations of zirconium and aluminum tube and fuel element surfaces. The zirconium surfaces did not contribute significantly to the effluent concentration of any radionuclides. ^{65}Zn was derived primarily from the aluminum tube. It was concluded that the radiozinc resulted from irradiation of zinc impurities in the aluminum tube, and entered the coolant either by corrosion or erosion of the tube surface. ^{56}Mn, ^{72}Ga, and ^{239}Np were formed in equal concentrations on the tube and fuel element surfaces and, like zinc, were presumed to have resulted from irradiation of impurities in the aluminum components. The production of the remaining isotopes favored the fuel element surface. Presence of small quantities of the precursors of ^{76}As, ^{32}P, ^{64}Cu, and ^{140}La in the coolant was contributory to the production of these radioisotopes. The relative production reflected a more favorable environment for adsorption of their parent isotopes on the fuel element surface. The addition of 1% nickel to the fuel cladding alloy was the obvious reason for the major contribution of ^{65}Ni from the fuel element surface. The production of ^{24}Na was attributed to the fast neutron reaction of ^{27}Al with subsequent release of sodium from the corrosion film to the coolant. The ratio of ^{24}Na contribution from fuel and tube was 2 : 1, approximately the same ratio as the fast neutron fluxes at the two surfaces. The use of deionized water, per se, did not provide significant reductions in the effluent concentrations of ^{32}P, ^{65}Zn, and to a degree ^{76}As, the three isotopes of biological interest. (auth)

Propulsion and Space

10604 (ANL-6828) PRELIMINARY PHYSICS AND HEAT TRANSFER DESIGN CALCULATIONS FOR A ROCKET FUEL TEST REACTOR (RFTR). D. R. MacFarlane and J. T. Madell (Argonne National Lab., Ill.). Aug. 1964. Contract W-31-109-eng-38. 57p. Dep.; $3.00(OTS).

The concept of a test facility with which to evaluate nuclear rocket fuel elements at operating conditions was investigated. The major requirement established for such a test facility was that it produce up to a maximum power density of 10 kw/cm^3 in the test section while the test reactor was limited to a power density of 2 to 2.5 kw/cm^3. Calculations were performed to determine the characteristic of a test facility which would achieve the desired levels of power density. The dimensions, composition, power production, coolant flow, and fuel element size of the test reactor were among the characteristics of interest. The preliminary investigation showed that a test facility with the desired power density ratio was feasible, but that it produced large amounts of power. The results also indicated that optimization of the test reactor could reduce the total power without changing the power density ratio. (auth)

10605 (APEX-524) AN ANALYSIS OF LATE 1957 AND EARLY 1958 LID TANK EXPERIMENTS PERTAINING TO XMA-1 SHIELD DESIGN. S. T. Friedman (General Electric Co. Aircraft Nuclear Propulsion Dept., Cincinnati). June 1958. Contracts AT(11-1)-171 and AF33(600)-38062. 52p. Dep.(mn); $3.00(cy), 1(mn) OTS.

Experiments performed at the ORNL Lid Tank Shield Facility are analyzed. A lengthy discussion of secondary gammas and their relevance to XMA-1 shield design in light of these experiments is given. Information about the suppression of secondaries with boral and about the relative merits of Hevimet, uranium, and stainless steel as gamma shielding materials is presented. (auth)

10606 (GEAP-3174) PRESSURE DROP THROUGH 25-ROD PARTIAL PROTOTYPE AT 520°F AND 1100 psi. N. S. SAVANNAH FUEL DEVELOPMENT PROGRAM. E. E. Polomik (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 22, 1959. Contract AT(04-3)-189. 64p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Experimental pressure drop measurements with subcooled water were made on a 21-rod fuel bundle which is a partial prototype of the N. S. Savannah fuel bundle. The flow section consisted of 21 fuel rods 0.563 in. OD, and 4-$^3/_8$ in. OD dead rods, held together with upper and lower tie plates and a spacer at approximately the middle of the rods. A few runs were made at temperatures of 75°F to obtain data at low Reynolds numbers. Pressure drop measurements were made with and without the fuel bundle assembled in the channel. The tests included measurements at various flows of friction losses, pressure drop at the spacers, distance for spacer expansion recovery, and pressure loss at the upper and lower tie plate (obtained from the difference in readings of runs with and without the fuel bundle in the channel). (D.L.C.)

10607 (GEAP-3194 & Add.) THERMAL SHOCK CONDITIONS AND HISTORY OF OPERATING CONDITIONS IN HEAT TRANSFER FACILITY FOR N. S. SAVANNAH 25-ROD PARTIAL PROTOTYPE FUEL ASSEMBLY. N. S. SAVANNAH FUEL DEVELOPMENT PROGRAM. E. E. Polomik (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). June 18, 1959. Contract AT(04-3)-189. 20p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A partial prototype fuel rod assembly approximately 70 inches long consisting of 21, 0.5625-inch OD rods in a 5 × 5 array on 0.770 inch centers with 4, $^3/_8$-inch corner dead rods was given 18 thermal cooling shocks from a temperature of 520°F. The total cooling range averaged 175°F at a mean rate of 32°F/minute. The fuel rod assembly was operated from room conditions of 70°F and a pressure of 20 psig to maximum temperature and pressure of 540°F and 1250 psig, respectively. Flow rates varied from 2 to 23 lb water/second (corresponding mass velocities of 9.44×10^4 to 94.4×10^4 lb/hr ft^2). (auth)

10608 (GEAP-3224) FUEL TIME CONSTANTS AND CONTROL ELEMENT SLOT COOLANT FLOW FOR N. S. SAVANNAH REACTOR CORES I AND II. P. M. Blair (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Aug. 11, 1959. Contract [AT(04-3)-189]. 12p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Predicted time constants (times at which 63.2% of the maximum steady-state surface heat flux is reached during an increase from zero to maximum power) are given for Cores I and II at start and end of fuel life. Graphs are given of the temperature distributions in the fuel rod at beginning and end of life. Calculations are given for the control element slot coolant flow for Core II. (D.L.C.)

10609 (GEAP-3244) THERMO-HYDRAULIC STEADY-STATE ANALYSIS. N. S. SAVANNAH FUEL DESIGN AND DEVELOPMENT PROGRAM. P. M. Blair (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 10, 1959. Contract AT(04-3)-189. 37p. Dep.(mn); $2.00(cy), 1(mn) OTS.

A burnout analysis was made for steady-state operation of the Core II fuel assembly for the N. S. Savannah, both for a fuel channel as a whole and for six subchannels among the fuel rods in a region near the corner of a channel. The results indicate that the closest approach to burnout in steady-state operation occurs in subchannel "B." This closest approach to burnout is indicated by the minimum value of the burnout margin which is, for subchannel "B," 4.96, and this minimum is located about half-way up the active fuel length. The power level which would be necessary to cause burnout is 395%. There will be no bulk boiling in steady-state operation. In fact, the power level which would be necessary to cause bulk boiling is 375%. The fuel time constants were computed based on clad outer surface heat flux for Cores I and II. The Core II time constant is about 36% larger than the Core I time constant at the start of fuel life but only 10% larger at the end of life. Fuel rod center temperatures are also calculated for both Cores I and II. The effect of larger coolant flow rate in the Core II is considered. (D.L.C.)

10610 (GEAP-3249) INVESTIGATION OF THE MECHANICAL PROPERTIES OF THE FUEL ASSEMBLY. N. S. SAVANNAH FUEL DESIGN AND DEVELOPMENT PROGRAM. R. G. Cochran (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 21, 1959. Contract AT(04-3)-189. 31p. Dep.(mn); $2.00(cy), 1(mn) OTS.

Results are reported of an investigation of the mechanical behavior of a dummy prototype fuel assembly as a replacement fuel for the NS Savannah. The dummy differs from the production fuel assembly in that lead is substituted for the UO_2 fuel. The tests carried out include deflection under various inclinations, torque vs twist angle, space envelope requirements, and center spacer flexibility. The results are extrapolated to the production fuel assembly, and it is concluded that the assembly can be fabricated within the dimensional limitations of the core structure, and that it possesses sufficient flexibility. (D.L.C.)

10611 (GEAP-3329(Rev.1)) BURN-OUT ANALYSIS. N. S. SAVANNAH FUEL DESIGN AND DEVELOPMENT PROGRAM. C. E. Lundgren and Revised by S. G. Sawochka (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Sept. 20, 1960. Contract AT(04-3)-189. 15p. Dep.(mn); $1.00(cy), 1(mn) OTS.

With a pump flow rate of 8.68×10^6 lbs/hr, derived from the calculated pressure drop 154 ft in the primary system and the given pump characteristics, it is found that subchannel "E" in a centrally located fuel channel in the third pass imposes the most severe burn-out conditions. Burn-out is to be expected there at 3.85 times rated power, the minimum burn-out margin at 25% overpower being 4.39. Bulk boiling will begin in this subchannel at 3.45 times rated power. The rate of coolant flow through the control element slots is estimated to be 8.5% of the total flow or 740,000 lbs/hr. (auth)

10612 (GEAP-3330) PRESSURE LOSSES AND FLOW RATES IN FUEL ASSEMBLIES. N. S. SAVANNAH FUEL DESIGN AND DEVELOPMENT PROGRAM. C. E. Lundgren (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Jan. 28, 1960. Contract AT(04-3)-189. 13p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Due to slightly modified calculation methods and small changes in design, the previously committed pressure losses are changed by a small amount, now being 1.30 psi and 1.04 psi for 2nd and 3rd pass at a total flow rate of 8×10^6 lbs/hr (as against 1.04 and 0.77 psi formerly). The actual pumps flow rate is found as 8.70×10^6 lbs/hr, yielding 63.1 psi and 2.76 psi pressure losses for the total primary system and the fuel respectively. (auth)

10613 (GEAP-3339) STRESS ANALYSIS OF THE FUEL RODS USED IN THE N. S. SAVANNAH CORE II. N. S. SAVANNAH FUEL DESIGN AND DEVELOPMENT PROGRAM. F. C. Rally (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Mar. 7, 1960. Contract AT(04-3)-189. 46p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The bending, thermal, and pressure stresses are investigated in the N. S. Savannah Core II stainless steel fuel cladding operating at maximum normal overpower conditions. The resulting combined stresses are compared to the material properties of the cladding to determine the minimum safety factor available under such conditions. (auth)

10614 (GEAP-3381(Rev.1)) FUEL ELEMENT INTERNAL PRESSURE CONSIDERATIONS, SAVANNAH CORE II. N. S. SAVANNAH FUEL DESIGN AND DEVELOPMENT PROGRAM. C. N. Spalaris and E. Mangrum, Jr. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). June 20, 1960, Revised Sept. 12, 1960. Contract AT(04-3)-189. 56p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Data from the fuel assemblies irradiated in the VBWR are used to calculate internal pressure build-up in Savannah fuel due to fission gas release. Three cases were analyzed: primary fuel segment, special fuel segment, and abnormal fuel segment (abnormal control rod setting). (D.L.C.)

10615 (GEAP-3445) N. S. SAVANNAH PROTOTYPE FUEL ASSEMBLY TENSILE AND COMPRESSIVE LOADING TESTS. N. S. SAVANNAH FUEL DESIGN AND DEVELOPMENT PROGRAM. R. G. Cochran (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 9, 1960. Contract AT(04-3)-189. 8p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Results are reported of tensile and compressive tests of the dummy prototype Core II fuel assembly. The tensile tests with up to 2500 lb force showed no lengthening or damage of the assembly. The compression test with a force of 2600 lb gave a length decrease of 0.18 inch, owing to compression of the thermal expansion springs. (D.L.C.)

10616 (GNE/Phys-64-14) NUCLEAR CRITICALITY CALCULATIONS ON A SPHERICALLY SYMMETRIC GASEOUS-CORE REACTOR (thesis). John Richard Rec (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). May 1964. 118p. (AD-603614) $4.00(OTS).

The nuclear criticality calculations are performed on a two-region, spherically symmetric, gaseous-core reactor. The core is fueled with ^{235}U vapor and is externally moderated by various thicknesses of graphite at 4000°K. A one-group (thermal) transport analysis with a fast effect correction, which accounts for above-thermal fissions and absorptions, is used to perform the criticality calculations. The thermal-group analysis is developed by applying the S_n transport approximation to the one-velocity, one-dimensional, time-independent Boltzmann transport equation. Age-diffusion theory is used to estimate the fast effect correction. The criticality calculations are done on the IBM 7090 digital computer, and results are compared with results from a multigroup transport analysis for similar reactor configurations. (auth)

10617 (NAA-SR-Memo-10286) QUALIFICATION TEST OF SNAP-10A RELAYS, 10FS-24008 AND 10FS-24010. J. Lowenson and M. Christian (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 1, 1964. Contract [AT(11-1)-Gen-8]. 71p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Eighteen non-latching and 18 latching relays were qualification-tested. These relays use polyvinylidene fluoride shrink tubing for their coil insulation. Test results are tabulated. (auth)

10618 (NAA-SR-Memo-10399) SNAP-10A PbSnTe T/E PUMP S/N-032 ACCEPTANCE TEST. C. M. Quirk and T. M. Funakura (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 2, 1964. Contract [AT(11-1)-Gen-8]. 28p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The SNAP 10A PbSnTe T/E pump was acceptance-tested. Data are submitted, with a short summary of the results. The maximum output obtained during the orbital full flow test was measured as 15.10 gpm of 1010°F NaK at a pressure of 1.053 psi. The maximum output obtained during the pre-reactor-startup test at a NaK temperature of 90°F was measured to be 0.35 gpm at a pressure of 0.00614 psi, with a startup current of 40 amp d-c. The pre-reactor-startup test was performed at four test conditions: 100°F NaK and 90°F sink; 90°F NaK and 90°F sink; 80°F NaK and 90°F sink; and 80°F NaK and 70°F sink. (auth)

10619 (NAA-SR-Memo-10421) A METHOD OF CALCULATING ANNULAR VOID REACTIVITY EFFECTS IN CYLINDRICAL REACTORS. R. H. Norman, D. G. Oliver, and W. R. Castle (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 9, 1964. Contract [AT(11-1)-Gen-8]. 87p. Dep.(mn); $3.00(cy), 3(mn) OTS.

A problem of increasing concern in reactor neutronic analysis is the criticality calculation of a reactor containing a void gap. A method is developed for calculating annular void sleeve reactivity worths in SNAP reactors. A code was developed to compute a geometrical escape probability and absorption cross section (DB^2) for the void region. This DB^2 is derived from S_n transport theory and characterizes axial leakage from the void in reactivity calculations with the DTK S_n transport code. Calculations of void sleeve reactivity worths by this method for the water immersed S8ER core compare very well with measurements. (auth)

10620 (NAA-SR-Memo-10464) SNAP-10A PbSnTe T/E PUMP S/N-033 ACCEPTANCE TEST. C. M. Quirk and T. M. Funakura (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 24, 1964. Contract [AT(11-1)-Gen-8]. 27p. Dep.(mn); $2.00 (cy), 1(mn) OTS.

The SNAP-10A PbSnTe T/E pump was acceptance-tested. Data are submitted, with a summary of the results. The maximum output obtained during the orbital full-flow test was measured as 15.10 gpm of 1010°F NaK at a pressure of 1.055 psi. The maximum output obtained during the pre-reactor-startup test at a NaK temperature of 90°F was measured to be 0.35 gpm at a pressure of 0.0081 psi, with a startup current of 40 amp d-c. (auth)

10621 (NAA-SR-Memo-10480) SNAP-10A PbSnTe T/E PUMP S/N-034 ACCEPTANCE TEST. C. M. Quirk and T. M. Funakura (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 25, 1964. Contract [AT(11-1)-Gen-8]. 27p. Dep.(mn); $2.00 (cy), 1(mn) OTS.

The SNAP-10A PbSnTe T/E pump was acceptance-tested. Data are submitted, with a summary of the results. The maximum output obtained during the orbital full-flow test was measured as 15.52 gpm of 1010°F NaK at a pressure of 1.077 psi. The maximum output obtained during the pre-reactor-startup test at a NaK temperature of 90°F was measured to be 0.39 gpm at a pressure of 0.00814 psi, with a startup current of 40 amp d-c. (auth)

10622 (NAA-SR-Memo-10494) DRUM CONTROLLER SIMULATION ON AN ANALOG COMPUTER. L. N. Wimberly (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Oct. 1964. Contract [AT(11-1)-Gen-8]. 10p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A drum controller simulation for analog computer studies of SNAP-8 nuclear reactor systems is described. Wave shapes at significant points in the simulation are recorded and adjustment procedures are outlined to provide a record of operation. (auth)

10623 (PWA-2351(Vol.1)) DESIGN STUDY OF A HIGH-POWER IN-PILE NUCLEAR THERMIONIC SPACE POWERPLANT. Final Report. A. U. Buatti and J. W. Schmitt (Pratt and Whitney Aircraft Div., United Aircraft Corp., Hartford, Conn.). July 30, 1964. Contract NASw-763. 220p. (NASA-CR-54172; N65-11041). $6.00(OTS).

Preliminary design studies of a 3.25 Mw in-pile nuclear thermionic space powerplant are reported. The design of the powerplant is based on a systems analysis that varied component and system parameters to determine system performance. The powerplant is described and an evaluation of its performance is given. Major technical problems and uncertainties are discussed. Supporting detailed design and analytical studies and materials data are given. (auth)

10624 A STEAM-CYCLE POWER PLANT FOR HIGH-POWER COMMUNICATIONS SATELLITES. Henry R. Kroeger and Jerry Grey (Radio Corp. of America, Princeton, N. J.). Advan. Energy Conversion, 4: 51-70(Nov. 1964).

A conceptual design study for a steam-cycle power supply which provides the required specific weight (around 50 lb/kwe) together with a reasonable expectation of obtaining the required one-year minimum lifetime is presented. The proposed cycle is the conventional Rankine steam cycle utilizing superheated turbine-inlet steam at 1200 psi and 1200°F. After removal of residual superheat in a recuperator, the saturated vapor at the turbine exhaust is condensed in a radiator at approximately 400°F and returned by a pump to the energy source. At first glance, it does not appear possible to reject heat at such a low temperature without enormous radiator weights. Indeed, the radiator surface area is considerably larger than that required for the much higher temperature liquid metal or gas cycles. However, the unique combination of using steam at low temperatures permits the utilization of two design features which provide remarkably low radiator weight per unit area in the conventional flat fin-and-tube configuration. First, the high latent heat of the condensing steam allows only small volumetric through-put per kilowatt output, resulting in very small tube diameters. Since the tubes and headers are the only major parts of the radiator that require meteoroid armor, the total tube and header weight does not become excessive. Second, because of the low temperature, it is permissible to use aluminum as the radiator material. Its high thermal conductivity therefore permits the use of quite thin, large-area fins between the tubes without suffering the conduction loss necessitated by the higher-temperature materials of other systems. Thus the fraction of radiator area occupied by the heavy, aluminum-armored tubes becomes quite small. In the sample design (30 kw) presented, the combination of small tubes and large fins results in a weight per unit radiating area of less than 0.25 lb/ft^2 of radiating area. The energy source may be either a nuclear reactor, the most favorable configuration of which would be a single-pass coiled-tube design (although more conventional boiler-superheater reactors may be used with little weight penalty), or a solar-powered boiler-superheater. Other cycle components are a conventional turbogenerator, recuperator and pump. The specific weight of the sample (30 kw) design is 70 lb/kw, but upon scaleup to higher powers, improved turbine efficiency, radiator segmentation, and reduced fractional weight of the energy source and turbine can provide estimated specific weights competitive with systems using other working fluids, with no sacrifice in reliability. With regard to reliability, the use of the conventional, long-operational steam cycle provides not only the benefit of many years of experience, but also the capability of using conventional materials; i.e., stainless steels and aluminum, for all cycle components. In consequence, although development problems will undoubtedly arise, there appear to be no significant state-of-the-art improvements required. It therefore appears possible with the proposed steam cycle to provide broadcast satellite power requirements in time to phase in with anticipated communications-system availability. (auth)

10625 THERMODYNAMIC CHARACTERISTICS OF BRAYTON CYCLES FOR SPACE POWER. Arthur J. Glassman and Warner L. Stewart (Lewis Research Center, Cleveland). J. Spacecraft Rockets, 1: 25-31(Jan.-Feb. 1964).

The Brayton cycle merits strong consideration for space power systems in which low specific weight is not a critical requirement. The results are presented of a theoretical investigation that was conducted in order to obtain an understanding of the thermodynamic characteristics of Brayton cycles for space application. It is shown that there are two independent temperature variables, ratio of turbine exit to inlet temperature and ratio of compressor inlet to turbine inlet temperature, which can be optimized on the basis of minimum radiator area. Radiator area, aside from depending on these temperature variables, depends on design factors such as turbine and compressor efficiencies, loss pressure ratio, recuperator effectiveness, turbine inlet temperature, sink temperature, and gas heat-transfer coefficient. All these factors are explored. The optimum values of the cycle temperature variables depend upon the particular values of the design factors. For design factors in the range of those usually encountered in a system design, the optimum values of turbine exit to inlet temperature ratio and compressor inlet to turbine inlet temperature ratio are generally in the range of 0.70–0.80 and 0.25–0.35, respectively. (auth)

10626 ANALYTICAL STUDIES OF BERYLLIUM ABLATION AND DISPERSION DURING RE-ENTRY. Alexander L. Feild, Jr. (Westinghouse Electric Corp., Pittsburgh). J. Spacecraft Rockets, 1: 31-6(Jan.-Feb. 1964).

Analytical studies were conducted to determine re-entry ablation of beryllium in SNAP-10A reactor reflectors and toxic hazard produced at ground level by the resultant residue dispersal. It was concluded that varying degrees of ablation will occur, depending upon re-entry attitude of reflector and point of release from the reactor. However, no ground level toxic hazard will exist, even with a reflector completely ablated at the lowest possible ablation altitude. (auth)

10627 ADVANCED SPACE MISSION CAPABILITIES OF NUCLEAR ROCKETS. W. C. Beckwith and H. L. Johnson (Aerojet-General Corp., Azusa, Calif.). J. Spacecraft Rockets, 1: 414-20(July-Aug. 1964).

Possible trends in the application of the solid-core, heat-exchanger type of nuclear rocket propulsion are indicated. Engine performance parameters, such as the propellant feed cycles, specific impulse, nozzle length, area ratio, and engine flow rate, are discussed briefly. Potential space missions are covered on the basis of the typical ranges of velocity (from orbital launch) required. Results are presented parametrically, permitting determination of engine thrust, I_{sp}, duration, and startup weight or delivered payload for any specific mission or velocity requirement. Performance data are presented in terms of hyperbolic excess velocity and actual velocity above escape. The results suggest that the best thrust levels for nuclear propulsion used for third and second stages on a Saturn V vehicle are in the ranges 0.2–0.3 and 0.8–1.0 million lb, respectively. These conclusions are based on both engine duration and payload achievable for a broad range of missions. (auth)

10628 RE-ENTRY BEHAVIOR OF ZIRCONIUM HYDRIDE-URANIUM FUEL ELEMENTS. Fred E. Littman (Stanford Research Inst., Menlo Park, Calif.). J. Spacecraft Rockets, 1: 421-6(July-Aug. 1964).

An important aspect of the utilization of nuclear auxiliary power systems in aerospace vehicles is the safe disposal of the radioactive materials they contain. The behavior of zirconium hydride-uranium fuel elements was investigated by subjecting them to stagnation pressure and heat-flux conditions for selected trajectories, using an arc image furnace. The results suggest that zirconium hydride-uranium is highly resistant to the conditions encountered on re-entry from a decaying orbit, making it unlikely that adequate dispersal of the fuel-element material can be achieved. (auth)

10629 NUCLEAR ENERGY TO POWER AIRCRAFT. Novica Vasiljevic. Vazduhoplovni Glasnik, No. 1, 62-73 (1964).

The general problems of atomic reactors are analyzed and the difficulty of applying the solutions found for stationary reactors to atomic aircraft engines are pointed out. The specific problems associated with the use of atomic fuel for a variety of aircraft propulsion systems are discussed. (auth)

10630 POLUPROVODNIKOVYE UPRAVLYAYUSHCHIE USTROISTVA DLYA SUDOVYKH ATOMNYKH USTANOVOK. (Transistor Control Devices for Nuclear Ship Installations). V. V. Pvlov. Leningrad, Izdatel'stvo "Sudostroenie," 1964. 168p.

Calculations and construction of electron semiconductor reactor control and safety instrumentation are described. Radiation effects on the semiconductor devices and performance and safety of various types of semiconductor transistors used in maritime reactor installations are discussed. (R.V.J.)

10631 APPLICATION OF SNAP POWER PLANTS FOR THE LUNAR BASE MISSION. W. O. Ackerman and R. E. Wimmer (Atomics International, Canoga Park, Calif.). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-712, 18p. $1.00. (CONF-640901-2)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

Presented are two conceptual designs for a nuclear lunar base power plant based upon the utilization of SNAP 8 components. One is an integral design with a 4π, earth-fabricated shield for the reactor. This plant requires very little installation effort. The total weight of this system is limited to 25,000 lb, estimated to be the payload capacity of Saturn V booster and lunar logistics vehicle. Consequently, shield weight limitations result in an exclusion radius of more than one third mile. This plant produces approximately 45 kw. The second concept is based upon the burial of the reactor below the lunar surface to provide radiation shielding. This requires considerably more installation effort than the integral design. The plant weight is only 6500 to 8500 lb, however, depending upon the criteria used to calculate meteoroid armoring. The exclusion radius for this plant is less than 100 ft and 50 kw of power is produced. (auth)

10632 THE SAFETY OF AEROSPACE NUCLEAR SYSTEMS. Douglas G. Harvey (Martin Co., Baltimore). 23p. (CONF-642-3)

From Health Physics Society, Cincinnati, June 1964.

The safety of nuclear devices for power and/or propulsion aboard space systems is examined with primary emphasis on radioisotope power systems. The procedures and techniques used to analyze the safety of a system are followed from launch phase aborts through re-entry burnup. It is concluded that under the analysis, design, and test process used the potential hazard to the public from aerospace nuclear systems is essentially nil. (H.D.R.)

10633 NUCLEAR ELECTRIC POWER FOR MANNED SPACE STATIONS. B. J. Tharpe and A. J. Arker (General Electric Co., Philadelphia). New York, American Inst. of Aeronautics and Astronautics, 1964, Paper No. 64-713, 48p. $1.00. (CONF-640901-1)

From 3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1964.

The engineering considerations in the adaptation of nuclear power systems as the prime electric power source for manned orbiting space stations are discussed. Attention is given to the power system and to interactions between the station and the power system. The systems treated utilize a SNAP-8 reactor coupled with either mercury Rankine or thermoelectric power conversion. It is concluded that such systems would be reliable power sources for the space stations currently being considered. (H.D.R.)

Research and Test Reactors

Refer also to abstract 10481.

10634 (ANL-6927) A ZONED LOADING FOR A ZPR-III-TYPE FACILITY. A. G. Edwards (Argonne National Lab., Ill.). Aug. 1964. Contract W-31-109-eng-38. Dep.; $2.00(OTS).

A series of calculations, centered around a possible zoned critical in a ZPR-III-type machine, is presented and discussed. Criteria of selection for equivalent samples and optimum drivers are discussed. The conclusion is drawn that measurements on a combination of one or more zoned criticals, and the careful computation of correction terms, can yield nearly all the experimental data that might be derived from a full-scale, all-sample critical, without significant loss of accuracy. The major exception is an experimental value for critical mass. (auth)

10635 (ANL-6935) SOME CONSIDERATIONS ON THE MELTDOWN PROBLEM FOR FARET. P. J. Persiani, A. Watanabe, U. Wolff, S. Grifoni, and B. Warman (Argonne National Lab., Ill.). Sept. 1964. Contract W-31-109-eng-38. 27p. Dep.; $2.00(OTS).

The reactor kinetics for a variety of positive reactivity-insertion rates and the effects from temperature-dependent negative reactivity feedbacks of a series of incidents which may lead to core melting have been studied. A Reactor Meltdown program was used to couple the dynamics of melting and subsequent collapsing of the core using the reactor kinetics equation. (auth)

10636 (APED-4454) FUEL ELEMENT ABRASION IN THE GENERAL ELECTRIC TEST REACTOR. R. H. Leyse (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). Nov. 26, 1963. 51p.

Structures in the reactor core become abraded because they vibrate against each other as a result of hydraulic forces. Abrasion is greatest in the vicinity of experimental assemblies; however, there is also significant abrasion at other core locations. Sometimes the abrasion of a fuel element is sufficient to wear away the aluminum clad and then uranium–aluminum alloy is exposed to primary cooling water. This is not a serious problem because the fuel alloy is corrosion resistant and therefore defects do not propagate except by further abrasion. The development of fuel element defects during reactor operation is detected by measuring the radioiodine concentration of the primary water. This method has proved to be workable and detected the development of a defect during Cycle 14 (July 1960). Two defective elements were not found until several months after they were removed from the reactor core. This probably will never happen again because of the close attention that is now focused on primary system radioiodine concentrations. The most severely defective element, F-21, was a burnout. This is not likely to recur because all fuel elements now have combs which maintain fuel plate spacing at the inlet end and prevent closure of outer flow channels from abrasion. There are indications that the reactor has operated with some fuel elements not fully inserted into the core. This is potentially an extremely dangerous situation and it is recommended that methods and procedures be effected which will ensure that this cannot happen in the future. Structures in the reactor core are still being abraded, and it is not likely that this will ever be completely eliminated. It is evident that experimental assemblies should be redesigned to minimize what may be the major source of core vibrations. (auth)

10637 (APED-4533) PRESSURIZED-WATER HARPS FOR NUCLEAR FUEL IRRADIATIONS IN THE POOL AT GETR. R. H. Leyse (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). May 4, 1964. 33p.

It is possible to irradiate nuclear fuel elements generating substantial amounts of power (150 kw) in relatively inexpensive and compact pressurized-water harps which can be installed in the pool at (GETR). These pressurized-water harps are similar to laboratory-type test harps which are commonly used for mass transport and corrosion studies; however, there are some modifications for temperature control and heat removal at the high-power generations. Power generations can range up to approximately 150 kw and are limited by the available neutron flux rather than by characteristics of the harps. Applications can include irradiation of defected fuel, deliberate thermal burnout under irradiation, and also the standard, long-term tests for burnup effects. (auth)

10638 (CEA-R-2518) RAPPORT DE SURETE DU REACTEUR PEGASE. TOME 1. DESCRIPTION DES INSTALLATIONS. (Safety Report Concerning the Reactor PEGASE. Volume 1. Description of Installations). Jean Lacour (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucléaires, Saclay); and Pierrette Legoin (Société d'Exploitation des Matérials Hispano-Suiza, Bois-Colombes, France). Aug. 1964. 566p. Dep.(mn).

Pegase is described, with a view to its safety. The Cadarache site at which they are situated is briefly described, in particular because of the consequences on the techniques employed for building Pegase. A description is also given of the original aspects of the reactor. The independent loops which are designed for full-scale testing of fuel elements used in natural uranium-gas-graphite reactor systems are described, together with their operational and control equipment. (auth)

10639 (CEA-R-2530) IRRADIATIONS SOUS CHAMP MAGNETIQUE. MESURES DE RESISTIVITE EN PILE. IRRADIATIONS SIMPLES DE 100 A 500°C EN PILE PISCINE. (Irradiations in a Magnetic Field. Measurements of In-Pile Resistivity. Simple Irradiations Between 100 and 500°C in a Swimming-Pool Reactor). Jean Pauleve, Andre Marchand, and Alain Blaise (France. Commissariat à l'Énergy Atomique. Centre d'Études Nucléaires, Grenoble). July 1964. 12p. Dep.(mn).

An oven is described which enables the irradiation of small samples in the maximum neutron flux of a swimming-pool reactor of 15 Mw (SILOE), at temperatures of between 100 and 500°C, defined to ±0.5°C. The oven is very simple from the technological point of view, and has a diameter of only 27 mm. This permits resistivity measurements to be carried out under irradiation in the reactor, and enables irradiations in a magnetic field of 5,000 oersteds, created by an immersed solenoid. (auth)

10640 (EACRP-U-18) LIST OF SUBCRITICAL FACILITIES (WESTERN EUROPE AND CANADA). (European-American Committee on Reactor Physics and European Nuclear Energy Agency, Paris). Sept. 1964. 20p. Dep.(mn).

The locations, names, operators, types, neutron sources, and operating histories of western European and Canadian subcritical facilities are listed. 27 references. (T.F.H.)

10641 (EUR-2178.e) GAMMA HEAT GENERATION IN THE 4GV1 BEAM OF THE ISPRA-I REACTOR. C. Bassani and P. Cerutti (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 35p. Dep.(mn).

Methods of measuring gamma heat generation in the experimental beam 4GV1 of the Ispra-I Reactor are described. Data from a calorimetric method and a graphite CO_2 ionization chamber are presented. A theoretical evaluation of the gamma heat generation in the measuring position, worked out for comparison with the experimental results, is also included. (auth)

10642 (EURAEC-1194) OSCILLATION OF URANIUM FUEL SLUGS IN "MARIUS." Special Report No. 20, July–August 1963. O. Tretiakoff, R. Vidal, J.-C. Carre, and M. Robin (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Fontenay-aux-Roses). May 1964. Work Performed under United States–Euratom Joint Research and Development Program. 49p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The accuracy of the measurements and their reproducibility is satisfactory. The perturbations due to geometry, diffusion, and mass effects have been demonstrated and specifications for the new samples are now perfectly well defined. Experiments with various chambers and comparison with 1962 results show that spectrum perturbation was very low but could be corrected and that the effect of graphite sleeves on the local ^{235}U signal was extremely important. Future experiments must be developed to interpret the Cu and U_5 equivalences particularly in order to define the correspondence between surface Cu and a homogeneous absorber. It is feared that the uranium–boron alloys previously scheduled for this study do not have, as those used in 1963, the required homogeneity characteristics and a boron content known with sufficient accuracy. Heterogeneous poisoning methods according to known laws will however enable this systematic study to be made. (auth)

10643 (EURAEC-1198) MARIUS—MEASUREMENTS OF SPECTRUM INDICES IN THE LATTICES OF 224 AND 317 mm PITCH. Special Report No. 23. F. Cogne and J. Journet (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). May 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 037-60-12 RDF. 87p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Measurements of the Pu/U, In/Mn, and Lu/Mn spectral indices carried out in Marius are summarized. The measured values are compared with cross sections calculated using various models. (T.F.H.)

10644 (HW-61657) SAFEGUARDS ANALYSIS OF THE PRTR ON AN ANALOG COMPUTER. W. D. Cameron (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 7, 1959. Contract AT(45-1)-1350. 25p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Reactivity disturbances in PRTR, assumed to occur from combinations of equipment failures and personnel errors, are considered. Analog methods used to analyze the dynamical response of PRTR to these disturbances, from the standpoint of possible reactor and fuel damage, are described. Both startup and on-power accidents are considered. The GEDA analog computer is used. (T.F.H.)

10645 (HW-81397) THE D_2O MODERATOR LEVEL COEFFICIENTS OF THE PRCF. V. O. Iotinen and L. C. Schmid (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 27, 1964. Contract AT(45-1)-1350. 18p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Analysis of the PRCF moderator level coefficients by the Fermi age model of diffusion theory is satisfactory. From the analysis of the migration area of the D_2O moderated core was found to be 344 ± 11 cm^2. (auth)

10646 (HW-83336) REPORT ON A PCTR ANALOG COMPUTER SIMULATION. C. Metalmann (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 17, 1964. Contract AT(45-1)-1350. 14p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Safety hazards in the Physical Constants Testing Reactor are analyzed using analog computer methods. Reactivity excursions are initiated by ramp or step inputs and terminated by either rod drops or fuel element melting. (T.F.H.)

10647 (HW-83337) TTR ANALOG COMPUTER SIMULATION. C. Metelmann (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 22, 1964. Contract AT(45-1)-1350. 15p. Dep.(mn); $1.00(cy), 1(mn) OTS.

An analog-computer simulation is used to evaluate the effects of a reactivity excursion terminated by a rod drop and/or self-limiting properties of the Hanford Thermal Test Reactor (TTR). The primary inherent shutdown characteristic of TTR is the formation of steam voids, which have a negative reactivity. The analog system is diagrammed. (T.F.H.)

10648 (IDO-16981) PRELIMINARY SAFETY ANALYSIS REPORT—LOFT FACILITY. F. W. Ahrens, G. A. Dinneen, R. D. Fletcher, et al.—J. M. Waage, ed. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Apr. 1964. Contract [AT(10-1)-205]. 406p. Dep.(mn); $7.06(cy), 6(mm) OTS.

Engineering tests must be carried out to investigate the consequences of a loss of coolant accident with a pressurized water power reactor. These tests will be conducted in a new facility to be constructed and which will be designated as LOFT (Loss of Fluid Test). A preliminary safety analysis has been performed to evaluate the potential hazards of conducting this test program, with the emphasis placed on determining the radiological hazards associated with the planned tests and on determining the potential hazards of the maximum credible accident. The basis for the analysis was the loss of coolant from a pressurized water reactor which had been operating at 50 Mw(t) in this facility for 800 continuous hours. The safety analysis is based upon estimates of fission product release, transport, and diffusion which could reasonably be predicted from existing experimental data. The meteorology at NRTS is used in computing the downwind radiological effects. Monitoring devices will be provided both inside and outside the LOFT containment building to assure early detection of a fission product release that could result in radiological doses above tolerance. A spray system is also provided that will permit sufficiently rapid pressure reduction in the containment vessel to reduce possible releases to the atmosphere to a safe level. The safety analysis of the maximum credible accident is based upon the postulation of a pipe break in both the primary and secondary coolant systems during adverse meteorological conditions. It is further assumed that a missile is generated as the result of the rupture with sufficient energy to penetrate the containment vessel. The same assumptions used in the analysis of the planned test were used to describe the fission product release and transport to the containment; however, the effects of pressure reduction sprays were included in estimating the release to the atmosphere. The results of this analysis indicate that the doses that could be received at the nearest site boundary are below the guide limits set for accidental releases to the atmosphere. In addition to the radiological analyses, brief discussions are given of the experimental program, design philosophy, experimental assembly, and LOFT facility. In addition, the safety analysis of the power operation and post-test phases of the program are summarized. It has been concluded that the loss of coolant test program can be carried out safely in the LOFT facility as presently conceived and currently located. (auth)

10649 (IDO-24467) ADVANCED TEST REACTOR. Final Shielding Design Report. J. O. Howard and G. M. Jacks (Babcock and Wilcox Co. Atomic Energy Div., Lynchburg, Va.). Dec. 1963. For Ebasco Services, Inc. Contract AT(10-1)-1075. 188p. Dep.; $6.00(OTS).

Calculation methods and engineering results for shielding analysis work done during the design of the Advanced Test Reactor are described. All calculations that are significant in the plant shield design are described. Also included are sections on heat generation rates, materials activation, and spent fuel and test element transfer. The calculation descriptions are divided into two parts, viz. the methods used to obtain the activity of the source, and those used for the geometry and attenuation equations from source to dose point. (auth)

10650 (IS-900(Sect.R)) REACTOR DIVISION. (Ames Lab., Ames, Iowa). 29p.

The development and use of the Ames Laboratory Research Reactor are discussed. Information is included on mechanical equipment and instrumentation, calibrations and measurements, and operating regulations. (J.R.D.)

10651 (LA-3190-MS) QUARTERLY STATUS REPORT ON ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) FOR PERIOD ENDING SEPTEMBER 20, 1964. (Los Alamos Scientific Lab., N. Mex.). Oct. 1964. Contract W-7405-eng-36. 21p. Dep.; $2.00(cy), 1(mn) OTS.

The development, construction, and testing of the Los Alamos Turret Reactor are summarized. Information is included on reactor vessel, carbon and graphite components, insulating carbon, fuel locks, fission heat test of coated fuel particles, control rod development and materials, helium blower tests, helium cooling system, systems analysis, graphite corrosion, neutronic calculations, and fuel element development and testing. (N.W.R.)

10652 THE SORA REACTOR PROJECT IN ISPRA. G. Ritter (Forschungszentrums, Ispra, Italy). Atomwirtschaft, 9: 606-10(Dec. 1964). (In German)

The Euratom Ispra Research Center has a comprehensive main division for reactor and neutron physics but no appropriately powerful source of neutrons. A pulsed fast reactor, SORA, which is being developed, is regarded in Ispra as being particularly suited to meet this deficiency. It is based on a pulsed reactor (the IBR) being operated in Dubna, USSR, with 1 kw power. SORA should produce, at a mean rating of 0.5 Mw, 100 pulses/sec each with a duration of 50 microseconds and a peak power of 60 Mw. The fuel will consist of 93% ^{235}U enriched U in the form of 24 cm long elements. Cooling will be by NaK. The reactor is controlled by the removal of parts of the fixed reflector. External to the reactor are two moderator blocks in which are produced delayed pulses of thermal neutrons with a maximum flux of about 10^{15} $n/cm^2/sec$. Radiation tubes lead the neutrons to experiments set up outside the screening. In addition radiation tubes for fast neutrons and an irradiation source are planned. Although SORA is optimized for specific experiments it will have further application possibilities. The reactor can take over an essential part of the work of a high flux reactor at only a fraction of the cost and with essentially lower operating costs. It is therefore hoped in Ispra that basic decisions favorable to the project will soon be made by Euratom. (auth)

10653 RADIATION SHIELDING ON THE KEMA SUSPENSION TEST REACTOR (KSTR). H. Wijker. Atoomenergie Harr Toepassingen, 5: 187-94(Sept. 1963); 199-206(Oct. 1963).

A critical study was made on the possibility of completely shielding the KSTR reactor by means of thermal and biological shields. Arrangement of the thermal shields between the reactor and reactor hall and their thickness are explained. The biological shield, which is also dealt with, will permit, should it be necessary, a stay of unlimited duration in the vicinity of the reactor hall, and, with certain restrictions, in various workplaces within the reactor hall. Stack emission is also discussed. (Occupational Safety Health Abstr., 2: No. 6, 1964)

10654 EXPERIMENTAL MEASUREMENTS MADE WITH THE "ARGOS" AND "ARBI" REACTORS. Carlos Fernandez Palomero and Lus Alvarez de Buergo (Junta de Energia Nuclear, Madrid). Energia Nucl. (Madrid), 8: 4-24(July-Sept. 1964). (In Spanish)

The position of the neutron source used to activate the Argos and Arbi Reactors was changed. The effects of this on the startup conditions were determined. Critical experiments and measurements of the reactivities of the control rods are also described. (J.S.R.)

10655 AUTOMATIC PROGRAMMED SAMPLE CHANGER FOR MULTIPLE MEASUREMENTS. Antonio Tanarro Sanz (Energia Nucl. (Madrid), 8: 41-7(July-Sept. 1964). (In Spanish)

The design, operation, and construction of an automatically programmed sample changer for the precise measurement of neutron flux distributions in the JEN reactor with probes is described. (J.S.R.)

10656 SAFETY FOR NUCLEAR-POWERED SPACE VEHICLES. Arthur J. Clark, Jr. (Sandia Corp., Albuquerque, N. Mex.). Mech. Eng., 86: No. 9, 36-9(Sept. 1964).

A safety program aimed at control of radiation hazards from the aerospace use of nuclear devices is discussed. It is noted that there must be no danger to populated areas from failures prior to launch or during flight. (J.R.D.)

10657 DETERMINATION OF EXCESS REACTIVITY AND CONTROL-ROD WORTH. T. Auerbach, T. Gozani, and P. Schmid (Eidenössisches Institut für Reaktorforschung, Würenlingen, Switzerland), Nucl. Sci. Eng., 21: 186-93(Feb. 1965).

The conventional method of determining excess reactivity and control rod worth by summing reactivity decrements in a heterogeneous poisoning experiment may give rise to serious errors because of the neglect of interference effects between rods and poison. It is suggested that interference may be accounted for by the simple assumption that it affects only the total control rod worth but not the shape of the normalized reactivity versus height curve. It is shown that this assumption allows results to be extrapolated back to the rod worth in the unpoisoned core. The method is demonstrated in two poisoning sequences carried out in the Swiss swimming pool reactor SAPHIR. The values obtained for excess reactivity and control rod worth agree well with each other and with a direct measurement. It is shown that the normalized regulating curve is indeed independent of poison and that the method of summing reactivity decrements is seriously in error when applied to the second poisoning sequence. (auth)

10658 INITIAL EXPERIMENTS ON THE CORNELL UNIVERSITY ZERO POWER REACTOR CORES. Selwyn Solomon Berg. Thesis, Ithaca, N. Y., Cornell Univ., 1964. 264p.

The reactors studied are heterogeneous, normal water-moderated, uranium–dioxide-fueled cores with water-to-fuel ratios of 1:1, 1.5:1, 2:1, 3:1, and 4:1. The fuel rods are held in a hexagonal array by upper and lower grid plates. The control rods are clusters of three poison-fuel elements. Each control element is 0.660 in. in outside diameter and has an upper section of packed boron carbide and a lower section of uranium dioxide fuel. These control rods are designed to be located anywhere in the core and are guided by the grid plates; with the control rods at their upper limits, the core is uniformly fuel and moderator. The initial experiments measured critical sizes, flux shapes, cadmium ratios, peripheral fuel rod worths, water gap worths, and control rod worths. The values and probable errors for these parameters are tabulated. Hand-computational methods of determining k by a multigroup technique, which uses four energy groups, and a multifactor technique, which uses a resonance fission factor in addition to the usual four factors, are shown. Control rod worths are calculated by both a simple two-group model and a modified two-group model that takes the flux perturbation into account. Agreement between theory and experiment in the determination of k was as good as expected; k was shown to be within 6% of one for the multifactor method and within 4% of one for the multigroup method. The poor agreement found between theory and experiment for the determination of control rod worths indicates the need for a better theoretical model. (Dissertation Abstr., 25: No. 3, Sept. 1964).

WASTE DISPOSAL AND PROCESSING

Refer also to abstract 9650.

10659 (EURAEC-703) UNDERGROUND RADIONUCLIDE MOVEMENT. Final Report No. 2, April 1, 1961–March 31, 1963. L. Baetsle, P. Dejonghe, W. Maes, E. S. Simpson, J. Souffriau, and P. Staner (Societe Belge de Chimie Nucleaire, Brussels). Work Performed under United States–Euratom Joint Research and Development Program. Contract 048-61-4. 175p. Dep.(mn); \$5.00(cy), 3(mn) OTS.

The movement of ground water is studied and the influence of the soil materials on the transportation of radioisotopes by the aquifer in a sandy or clayey underground is analyzed. For determining the exact pattern of ground water flow at a given spot, injection techniques were developed and detection devices built for direct sampling or chemisorption of radioactive tracers in the aquifer. A laboratory study of the aerated zone enabled determination of the variations in the permeability in terms of the humidity of a sandy profile. Studies concerning retention phenomena of radioisotopes by sorption on soil material led to the determination and calculation of relative velocities. They also permitted the development of methods making it possible to follow the variation in the distribution coefficient of a natural ion exchanger occupied with three macroscopic ions. For the migration of radioisotopes in a natural environment the calculation method based on the static distribution coefficient seems to be adequate. The analogy between the hydrodynamic and physical-chemical dispersion is examined in order to determine the relation between the parameters describing both phenomena. Some practical cases are presented and commented on. In order to verify the agreement between theory and field observations, relatively extensive strontium-89 and cesium-134 injections are at present being made. (auth)

10660 (HW-83218) FIRST IN-TANK WASTE SOLIDIFICATION UNIT INFORMATION MANUAL. J. J. Shefcik, comp. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1964. Contract AT(45-1)-1350. 47p. Dep.(mn); \$2.00(cy), 1(mn) OTS.

A description is given of the immobilization of high-level waste solutions containing low fission product concentrations by solidification within the underground storage tanks. The process operation, safety, and control are discussed. The following equipment is described: tank, air compressor, heater, circulator, deentrainer, filter, condenser, exhauster, pressure-vacuum relief, crib, instrumentation, sampling station, and piping. (D.L.C.)

10661 (HW-83461) ION EXCHANGE RECOVERY OF CESIUM FROM ALKALINE SUPERNATANT WASTE—SCALE-UP STUDIES. R. P. Popovich (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 1964. Contract AT(45-1)-1350. 45p. Dep.; \$3.00 (OTS).

A study was conducted on the operating parameters (kinetics and scale-up factors) for the ion exchange removal of cesium with the inorganic zeolite, AW-500. A synthetic Purex alkaline supernatant waste was used with a 2-in. inside diameter variable height column. The study resulted in the development of a model from which the breakthrough history of a tracer concentration solution may be estimated to within 10% over a wide range of operating parameters. The design parameters of 2.0 gal/min/ft^2 and 2.0 column volumes per hour have been specified for the removal of cesium from the waste. The estimated breakthrough history is defined for these parameters with AW-500. It was found that greater than 60 column volumes of influent can be processed with less than 1% accumulated breakthrough. This is well within the established design limits and indicates the feasibility of reducing the design volume of the column by 30%. (D.L.C.)

10662 (PG-Report-605) THE BIOLOGY OF THE SOLWAY FIRTH IN RELATION TO THE MOVEMENT AND ACCUMULATION OF RADIOACTIVE MATERIALS. IX. SEA-BED AND SEA-SURFACE DRIFTER RELEASES. C. N.E. IRISH SEA AND SOLWAY FIRTH 1963. E. J. Perkins, M. Bailey, and B. R. H. Williams (United Kingdom Atomic Energy Authority. Production Group. Chapelcross Works, Annon, Dumfriesshire, Scotland). 1964. 41p. Dep.(mn); \$2.00(BIS); 10s. (HMSO).

Results are reported from studies of the ebb and flow of tidal waters at the surface and sea bed levels of the Solway Firth and adjacent Irish Sea during 1962 and 1963. The movements of residual silts were also studied. Sea-bed and sea-surface drifters were released in batches of 25 or 50 and the distribution of recoveries analyzed. It was estimated that about 45% of the drifters released were recovered. The effects of rainfall, river flow, wind, tides, and other factors on distribution of the drifters are discussed. The relation of the movements of water and silt to the dispersal of radioactive wastes is implied. (C.H.)

10663 THE STORAGE OF RADIOACTIVE WASTE IN THE JULICH NUCLEAR RESEARCH CENTRE. K. H. Rattay and R. Schulze-Rettmer (Kernforschungsanlage, Julich, Ger.). Atomwirtschaft, 9: 617-19(Dec. 1964). (In German)

With the coming into operation of the first Institute of the Jülich Nuclear Research Center the necessity arose for a temporary, small storage place for weakly radioactive waste. For this purpose a small waste store with 60 m^2 surface was built and put into operation. Screening measures against gamma rays were not involved. Small quantities of waste of higher activity could be stored in safety either by screening with lead bricks or by the use of screened waste containers. To extend this small store a final store was constructed whose capacity should suffice for the next 5 to 6 years. This store, primarily intended for the Jülich Nuclear Research Center, was simultaneously to serve as a collecting place for radioactive waste for North-Rhine Westphalia. The new store is of a hangar construction of pre-cast, reinforced concrete. Ten cells of standard concrete open at the top and each with a base area of 100 m^2 serve as storage areas. To provide safety in case of earthquakes each of the cells is an individual building unit. The inner walls have a total thickness of 60 cm, the outer walls bounding the service passages are 70 cm thick. Inside the large storage cells are four smaller cells for the reception of waste with a high gamma activity. The waste is collected in barrels and subsequently stored in the cells. After completion of the decontamination plant, which is to be built during the next two years, the weakly radioactive waste already in store will be concentrated by incineration or by pulverization and compression. The realization of the waste store permits the storage of gamma emitters with an activity of up to about 1 million curies. The total cost of the erection of the store inclusive of the transporting arrangements and the measuring equipment amounted to DM 1.9 million. The storage capabilities of this Land collection center should suffice for all radioactive waste until such time as the problem of a central store for the Federal Republic has been solved. Then the radioactive waste from all the intermediate storage places will be transferred to a final store. (auth)

10664 THE PROBLEM OF FISSION PRODUCTS. ELIMINATION OR RECOVERY? Francoise Laveissière and André Raggenbass (CEN, Saclay, France). Euratom Bull., 3: No. 4, 12-16(Dec. 1964).

The problem of fission-product formation in reactors is reviewed. Possible solutions—long-term storage, storage through conversion to solid form, separation of specific isotopes for storage or use, and uses as radiation or heat sources—are surveyed. (M.J.T.)

10665 DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES. Rolf Eliassen (Stanford Univ., Calif.). J. Water Pollution Control Federation, 36: 201-16(Feb. 1964).

The present temporary and unsatisfactory disposal methods for nuclear wastes, and the need for a more reliable method at a reasonable cost are discussed. The failing points and inefficiencies of current methods of disposal are cited. Results are given of a recent study to incorporate the wastes into glass at high temperatures. An analysis of the problems that were confronted in the study and in the solutions is presented. As a result of the study, glass can be produced that will provide the necessary degree of security needed in high-level radioactive waste disposal by a method that can cope with the anticipated growth of the nuclear power industry. (auth)

10666 THE DISPOSAL OF RADIOACTIVE WASTE INTO IRRIGATION WATER. G. Michon. 9p. (CONF-642-2)
From Health Physics Society, Cincinnati, June 1964.

The disposal of radioactive waste into water streams used for irrigation was studied. Accumulation of long-lived radioistopes in the soil and plants from the irrigation water was studied. Data are presented in tables. It was concluded that the ICRP standards cannot be used as a basis for the disposal of radioactive waste in water used for irrigation since it allows man to be exposed to more radioactivity than is anticipated from the maximum permissible concentration. (M.C.G.)

GENERAL AND MISCELLANEOUS

10667 (BMI-X-322) THE CORROSION OF NICKEL COMBUSTION REACTORS. P. D. Miller, W. N. Stiegelmeyer, and W. K. Boyd (Battelle Memorial Inst., Columbus, Ohio). Dec. 29, 1964. Contract W-7405-eng-92. 16p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The V-102 Mark III finned combustion reactor at ORNL failed by leakage at several areas. A metallurgical study was made on sections cut from the failed reactor and two unfailed reactors in order to determine the failure mechanism. Extensive intergranular attack was found, and chemical analyses showed the grain boundary phase to be primarily nickel sulfide. A failure mechanism is suggested in which the nickel picks up sulfur from the graphite introduced into the reactor, and the resulting sulfide at the grain boundaries embrittles the nickel. (D.L.C.)

10668 (COO-1148-91) VOLTAMMETRIC BEHAVIOR OF AZOXYBENZENE, AZOBENZENE AND HYDRAZOBENZENE AT THE GRAPHITE ELECTRODE. Laura Chuang, Ilana Fried, and Philip J. Elving (Michigan. Univ., Ann Arbor). Dec. 1, 1964. Contract AT(11-1)-1148. 37p. Dep.(mn); $2.00(cy), 1(mn) OTS.

In aqueous 50% ethanol solution over the pH range of 1.6 to 12.5, azoxybenzene undergoes a $4\underline{e}$ reduction at the pyrolytic graphite electrode to hydrazobenzene, azobenzene a $2\underline{e}$ reduction to hydrazobenzene, and hydrazobenzene a $2\underline{e}$ oxidation to azobenzene. In all three cases, the half-peak potential, $E_{p/2}$, varies linearly with pH with a change in slope at about pH 6.5 for azoxybenzene and pH 9 for the other two compounds. The peak current, i_p, varies linearly with concentration for azoxybenzene and hydrazobenzene with an average current density in pH 3.1 buffer of 1.58 and 0.47 μa-l/mm^2 mmole, respectively. For azobenzene, the current density decreases as concentration increases from 1.12 at 0.2 m$\underline{M}$ to 0.73 at 1.2 m$\underline{M}$ and $E_{p/2}$ shifts to more negative potentials. $E_{p/2}$ for hydrazobenzene becomes less negative as concentration increases, while $E_{p/2}$ for azobenzene is unchanged. The polarographic behavior of the three compounds at the dropping mercury electrode has been critically evaluated and compared to their behavior at the graphite electrode. Generally, the azobenzene–hydrazobenzene system seems to be less reversible at the graphite electrode than at the mercury electrode. Qualitative examination of the effect of light on the photoisomerization of trans- to cis-azobenzene indicates that the process would normally have little effect on the observed voltammetric behavior of azobenzene. (auth)

10669 (COO-1148-92) VOLTAMMETRY OF THE QUINONE–HYDROQUINONE SYSTEM IN PYRIDINE AT THE PYROLYTIC GRAPHITE ELECTRODE. W. Richard Turner and Philip J. Elving (Michigan. Univ., Ann Arbor). Dec. 29, 1964. Contract At(11-1)-1148. 15p. Dep.(mn); $1.00(cy), 1(mn) OTS.

The electrochemical oxidation and reduction of quinone, hydroquinone, and quinhydrone in pyridine solution at the stationary pyrolytic graphite electrode has been studied by conventional and cyclic voltammetry. In the absence of available protons, quinone is reversibly reduced in a $1\underline{e}$ process to a free radical anion; in the presence of protons, the free radical produced on $1\underline{e}$ reduction is itself oxidized to an $\underline{N}$-dihydroxyphenyl pyridinium ion. The latter is also the product resulting from the $2\underline{e}$ oxidation of hydroquinone. The quinone-hydroquinone system itself is irreversible, e.g., quinhydrone behaves as a mixture of quinone and hydroquinone, the potentials of whose waves are 0.5 volt apart. (auth)

10670 (COO-1198-223) EFFECT OF APPLIED FIELDS ON THE OPTICAL PROPERTIES OF COLOR CENTERS (thesis). Charles Howard Henry (Illinois, Univ., Urbana). Feb. 1964. Contract AT(11-1)-1198. 141p. Dep.(mn); $4.00(cy), 3(mn) OTS.

A theoretical analysis is made of the effect of an external perturbation, such as an electric field or magnetic field, on the optical properties of color centers. The analysis is restricted to centers with orbital singlet ground states. It is especially applicable to centers with orbitally degenerate excited states that interact strongly with the lattices, such as the F center in the alkali halides. The changes in the optical properties are described by computing the changes that occur in the moments of the optical absorption line shape when the external perturbation is applied. The changes in the zeroth, first, second, and third moments may be computed quite simply. Although this does not give the detailed change in the line shape, it provides a precise method for evaluating parameters of the center, such as the spin-orbit coupling constant of the excited state of the F center. The method of moments is used to analyze experiments on the circular dichroism, Faraday rotation, Stark effect, and Voigt effect of the F center, and the circular dichroism of the A center. The analysis of circular dichroism data yields a method for determining the separate contributions to the broadening of the F band due to the cubic vibrational modes, the non-cubic vibrational modes, and the spin-orbit interaction. Data on the circular dichroism of the F band in CsBr and CsCl are analyzed. The analysis resolves the discrepancy between two methods of determining the spin-orbit splitting (measurement of the peak separation of the resolved structure, and measurement of the circular dichroism), and shows that the structure arises from a combination of a large spin-orbit coupling and a large non-cubic lattice vibrational interaction. (auth)

10671 (COO-1198-228) A MAGNETIC RESONANCE STUDY OF IRON IN SILVER CHLORIDE (thesis). John Campbell Garth (Illinois. Univ., Urbana). Nov. 1964. Contract AT(11-1)-1198. 65p. Dep.(mn); $3.00(cy), 2(mn) OTS.

The cubic electron spin resonance spectrum of Fe^{3+} in silver chloride was studied at 1.3°K by the Electron Nuclear Double Resonance (ENDOR) technique. ENDOR lines from 6 to 24 megacycles were observed on each of the five electron spin resonance transitions and have been identified as lines due to four chlorine nuclei which are nearest neighbors to the iron ion. The angular dependence of the crystal field splitting of the electron resonance, as the orientation of the applied field is varied, proves that the iron is in a site of cubic symmetry. The angular variation of the ENDOR spectrum, as the field is rotated in a (100) plane, shows that the iron cannot be in a site of octahedral symmetry and that it therefore must be in a site of tetrahedral symmetry. ENDOR lines of both chlorine isotopes were identified. ^{35}Cl ENDOR lines, characterized by $M_s = +3/2$ and $M_s = -3/2$, were studied with the applied field parallel to the (100) direction, and the best chlorine hyperfine and quadrupole coupling constants were determined for both isotopes. It is found that these constants can be used to predict the locations of all observed ^{35}Cl and ^{37}Cl ENDOR lines, but some discrepancies between the predicted spectrum and the observed lines remain which cannot be accounted for by effects of the cubic field splitting term in the spin-Hamiltonian. (auth)

10672 (IS-900) ANNUAL SUMMARY RESEARCH REPORT OF CHEMISTRY, ENGINEERING, METALLURGY, PHYSICS AND REACTOR DIVISIONS, JULY 1, 1963–JUNE 30, 1964. (Ames Lab., Ames, Iowa). Sept. 1964. Contract W-7405-eng-82. 463p. Dep.; $7.76(cy), 7(mn) OTS.

Research and development progress is reported on chemistry, engineering, metallurgy, physics, and reactors. A separate abstract was prepared for each topic. (J.R.D.)

For abstracts of individual sections see: 9046, 9281, 9604, 9767, and 10650.

10673 (IS-967) MICROWAVE MOBILITIES OF HOLES IN P-TYPE GERMANIUM. Bou-Loong Ho and G. C. Danielson (Ames Lab., Ames, Iowa). Aug. 1964. Contract W-7405-eng-82. 49p. Dep.; $3.00(OTS).

Hall mobilities of an n-type (GN 1) and a p-type (GP 2) germanium single crystal were measured at a microwave frequency of 9 Gc from 80 to 300°K. A bimodal rectangular cavity was used. The microwave signal was modulated by 1000 cycle per second square-wave signal. The microwave mobilities measured (with sample size correction factor of 0.423 for n-type and 0.687 for p-type germanium) were compared with the corresponding d-c Hall mobilities. For n-type germanium, the discrepancy between the d-c and microwave mobilities was believed to be predominantly due to acoustical mode scattering. For p-type germanium, a large deviation occurred at low temperatures. This result might be explained qualitatively as a combined effect of lattice and impurity scattering, particularly the effect of impurity scattering on the light mass holes. (auth)

10674 (K-1623) COMPUTER SIMULATION OF A TRUCK DISPATCHING SYSTEM. N. H. Van Wie (Oak Ridge Gaseous Diffusion Plant, Tenn.). Jan. 13, 1965. Contract W-7405-eng-26. 88p. Dep.; $3.00(OTS).

A truck dispatch system has been modeled for digital computer simulation studies. The model reproduced the existing situation satisfactorily and was then manipulated to indicate means of cost reduction and/or of improving service to customers. This report describes the model, the input data utilized, and some aspects of the results. (auth)

10675 (NAA-SR-9999) ANNUAL TECHNICAL PROGRESS REPORT, AEC UNCLASSIFIED PROGRAMS, FISCAL YEAR 1964. (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 31, 1964. Contract AT-11-1-GEN-8. 312p. Dep.; $7.00(cy), 5(mn) OTS.

The Sodium Reactor Experiment (SRE) achieved 20-Mw(t) operation during the report period and operated on a scheduled basis until planned shutdown. The shutdown marks completion of the first-phase SRE operation establishing the operational and maintenance practicality of large sodium-graphite reactor systems. In the evaluation program for Hallam reactor fuel elements the operating performance of U−10 Mo alloy and UC ceramics was studied. The performance of Hallam Core-I fuel consisting of U−10 Mo and UC elements was excellent. Operation of the Organic Moderated Reactor Experiment was concluded during the period and its custody transferred to the Phillips Petroleum Co. Hot-cell examinations revealed that APM (Al_2O_3−Al cermet)-clad UO_2 and Al-clad U−Mo elements performed well in burnups to 11,000 and 6900 Mwd/MTU, respectively. Test results on APM indicate that no major problems are to be expected in fabrication of APM-clad UO_2 fuel for the Piqua power facility. In the reactor safety program it was found that the technology developed for in-pile transient heating experiments is suitable for similar investigations using organic, liquid metal, or other coolants. In other work the theory of thermal neutron propagation through extended multiplying systems was formulated. A digital reactor dynamics simulator for analysis of reactor behavior was developed which incorporates the phenomenology of heat transfer, fluid flow, decay heat, fuel melting, and coolant boiling. A reactor siting code was developed for analysis of environmental hazards. Studies of fission product retention in Na revealed that rare gases constitute the major significant radiological release following injection of fission products into liquid Na. Experimental results on reactor housing indicate that the most inexpensive low-leakage structures are tilt-up concrete rectangular buildings. Work toward establishment of a basis for calculation of Doppler coefficients of reactivity is reported. Steady-state Na-boiling heat-transfer characteristics, void-fraction data, and critical heat flux of Na under forced convection flow were obtained with a forced-convection loop. A computer program was developed for use in analysis of single-channel boiling. Results of fire tests indicate that Na fires are extinguished when oxide building up from the bottom penetrates the burning liquid surface. Low-decontamination methods for processing reactor fuels are being investigated in laboratory experiments for use in selection of processes for scale-up. In a program to investigate nuclear characteristics of reactor lattices and neutron behavior in reactor materials, age measurements were made in Zr−water mixtures and were compared with Monte Carlo calculations. The computer programs MOMUS, GRAVE, and PRISM for analysis of neutron microscopic data to produce multi-group cross sections were written and checked. (J.R.D.)

10676 (NP-14551) REPUBLIC OF SOUTH AFRICA ATOMIC ENERGY BOARD SEVENTH ANNUAL REPORT, 1963. (South Africa. Atomic Energy Board, Pretoria). 48p. Dep.(mn).

The development and expansion of the activities of the Atomic Energy Board of South Africa are discussed. Topics covered include: uranium and nuclear materials production, geology, extraction and physical metallurgy, reactor engineering, application and protection aspects of radiation and radioisotopes, chemistry, physics, medicine and biology, agriculture, technical services, finances, administration, staff, publications, liaison and information services, and research planning. (N.W.R.)

10677 (NP-14552) SIXTH REPORT ON THE ACTIVITIES OF THE AGENCY. (European Nuclear Energy Agency, Paris). Sept. 1964. 192p. Dep.(mn).

Activities of the European Nuclear Energy Agency are summarized. Topics covered include: development and operation of the Eurochemic radiochemical processing plant, operation of the Halden Boiling Reactor, development of the Dragon reactor, critical assemblies, research reactors, nuclear power plants, power reactors, scientific co-operation, regulation and control, economic aspects, radioactivity, joint undertakings, nuclear data programs, production and uses of radioisotopes, radiation uses, health physics, nuclear physics, nuclear materials management, third party liability in the field of nuclear energy, and radiation protection. (N.W.R.)

10678 (NP-14615) REPORT ON THE ACTIVITIES OF THE TURKISH ATOMIC ENERGY COMMISSION, 1962−1963. (Turkey. Atomic Energy Commission, Ankara). 1964. 50p. Dep.(mn)

Activities of the Turkish Atomic Energy Commission during 1962 and 1963 are reviewed. The first Turkish Research Reactor (TR-1), located at Istanbul, became critical on Jan. 6, 1962, and small-scale isotope production was started in the fall of 1962. Four research establishments at the University of Ankara were completed and put into operation during the period. These include the Radioisotope Laboratory at the School of Agriculture, the Nuclear Chemistry Laboratory at the School of Science, the Subcritical Assembly at the School of Science, and the Electronics Maintenance Unit. Two courses on applications of radioisotopes in soil-plant relations were conducted. The organization of the Turkish Atomic Energy Commission is discussed and a list is included of publications during the period covered by this report. (C.H.)

10679 (NYO-2471-5) LUMINESCENCE AND PHOTOCONDUCTIVITY IN SILVER HALIDES (thesis). George Calvin Smith (Cornell Univ., Ithaca, N. Y. Materials Science Center). Feb. 1965. Contract AT(30-1)-2471. 120p. Dep.(mn); $4.00(cy), 2(mn) OTS.

The low-temperature luminescence and photoconductivity of AgCl and AgBr were studied simultaneously in order to determine the relationship between the two phenomena. The kinetics of response were studied using pulsed x-ray and pulse uv excitation. In AgCl, the luminescence efficiency and electron range (schubweg) are competitive forms of response as functions of temperature. At low temperatures, luminescence is dominant with characteristic decay time of about 25 microseconds. In the range of 30 to 40°K, luminescence decreases and photocurrent increases. These results are interpreted in terms of a model in which the luminescence center is a shallow electron trap (0.05 ev). The decrease of photocurrent at low temperatures is the result of the high probability for electron capture by the luminescence center. Under conditions of long electron lifetime, "breakdown" occurs in AgCl and AgBr at applied potentials in excess of 20 volts d-c. Currents as large as 10^{-3} ampere are accompanied by electroluminescence. This behavior is attributed to impact ionization of traps by "hot" electrons. (auth)

10680 (NYO-2471-6) DIELECTRIC PROPERTIES OF POTASSIUM HALIDES CONTAINING NO_2^- AND NO_3^- IONS (thesis). Report No. 290. C. Michael Moriarty (Cornell Univ., Ithaca, N. Y. Materials Science Center). Feb. 1965. Contract AT(30-1)-2471. 52p. Dep.(mn); $3.00(cy), 1(mn) OTS.

The real and imaginary part of the dielectric constant of various potassium halides, pure and doped with NO_2^- and NO_3^- ions, were measured in a frequency range from 500 cps to 100 kc and in a temperature interval from 2 to 300°K. Since the NO_2^- ion carries a permanent dipole moment and since the NO_3^- ion may be distorted, due to the crystalline field, to give rise to a dipole moment, contributions to the dielectric constant from the orientational polarizability can be expected and have been observed. In KCl only one orientation contribution was observed, while in KBr and KI several contributions exist. Dipole moments could be calculated, and when the orientation process was a thermally activated one, activation energies could be determined. (auth)

10681 (NYO-3018-7) STUDIES ON THE PRODUCTIVITY OF VASCULAR HYDROPHYTES AND THEIR ROLE IN MINERAL CYCLING IN AQUATIC ECOSYSTEMS. Progress Report, January 1, 1964–December 31, 1964. Richard T. Hartman (Pittsburgh. Univ.). Jan. 15, 1965. Contract AT(30-1)-3018. 56p. Dep.(mn); $3.00(cy), 2(mn) OTS.

Rates of carbon-fixation for naturally occurring plant communities are of great interest to ecologists concerned with ecosystem energetics. Results are reported from studies on the productivity of vascular hydrophytes and their contribution to aquatic ecosystems and the role of vascular hydrophytes in the cycling of mineral elements within aquatic ecosystems conducted at three separate aquatic areas located in northwestern Pennsylvania that differed considerably in community composition. Methods are described that were used for measuring carbon fixation, the internal gases of submersed vascular plants under various ecological conditions, and the relation of changes in the concentration of internal gases to the concentration of dissolved gases in the external water at various times during the diurnal cycle and at different seasons of the year. Data are included from pigment analyses of the plants and productivity under various environmental conditions. Preliminary results are included from studies on bacterial populations of the water. (C.H.)

10682 (SC-DC-64-2041) THE ROLE OF RELIABILITY IN DESIGN ACTIVITIES. A. C. Littleford (Sandia Corp., Albuquerque, N. Mex.). [1964]. Contract AT(29-1)-789. 27p. (CONF-641204-1). Dep.(mn); $2.00(cy), 1(mn) OTS.

The problems that systems designers face in creating reliable systems are outlined. The general responsibilities of a reliability organization are discussed, and some of the methods used in the reliability analysis of designs are described. Mechanical design considerations, human factor considerations, and reliability considerations for production are given. Failure reporting is considered. (D.L.C.)

10683 (SCL-DR-64-116) DIGPOD: A PROGRAM FOR COMPUTING WEIGHT, CENTER-OF-GRAVITY, AND MOMENT-OF-INERTIA USING A COORDINATE DIGITIZER. H. Quock (Sandia Corp. Livermore Lab., Livermore, Calif.). Jan. 1965. Contract [AT(29-1)-789]. 38p. Dep.(mn); $2.00(cy), 1(mn) OTS.

A FORTRAN program ("DIGPOD") was written for finding the weight, center-of-gravity, and moment-of-inertia of surfaces which have a constant lateral cross section. By using a coordinate digitizer, information can be taken directly from early design layout drawings and the study completed in less than a day by persons relatively untrained in programming techniques. (auth)

10684 (SC-R-64-1369) TRANSIENT RESPONSE OF A CLASS OF RECTANGULAR LOOP ANTENNAS. Trilochan Padhi (Harvard Univ., Cambridge, Mass. Gordon McKay Lab. of Applied Science). Nov. 1964. Contract AT(29-1)-789. 22p. Dep.(mn); $1.00(cy), 1(mn) OTS. Sandia Corp. Monograph.

The transient response characteristics of rectangular loop antennas, with one pair of sides of length much smaller than the cut-off wavelength of the measuring apparatus, are measured. An approximate theory is also presented, which agrees quantitatively with the experimental results. (auth)

10685 (SC-TM-64-58) THIRTY-CHANNEL PAM ELECTRONIC COMMUTATOR. E. L. Johnson, and P. R. Palmer (Sandia Lab., Albuquerque, N. Mex.). Mar. 1964. Contract AT(29-1)-789. 18p. Dep.(mn); $1.00(cy), 1(mn) OTS.

An introduction to, and an explanation of, the theory of operation of a 30-channel PAM (pulse-amplitide modulation) electronic commutator, including specifications and directions for modification to a 32-channel PCM (pulse-code modulation) commutator, are presented. (auth)

10686 (SC-TM-64-541) OPERATION MANUAL FOR FIELD FREQUENCY GENERATOR. H. W. Loemker (Sandia Lab., Albuquerque, N. Mex.). Oct. 1964. Contract AT(29-1)-789. 52p. Dep.(mn); $3.00(cy), 2(mn) OTS.

A Field Frequency Generator is described that is designed to calibrate discriminators on an FM-FM telemetry receiving station. The generator can provide high, low, and center-point frequency references for 14 IRIG subcarrier bands, either individually or in any combination from 1 to 14 simultaneously. In addition, the generator has a 100-kc crystal-controlled reference, which can be used to set up a tape compensation 100-kc discriminator. (auth)

10687 (SC-TM-64-996) APPLYING THE ABSOLUTE TOLERANCE CONCEPT TO NORMAL DISTRIBUTION PROCESSES AND MEASURING SYSTEMS. J. H. Walker (Sandia Lab., Albuquerque, N. Mex.). Sept. 1964. Contract AT(29-1)-789. 27p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The present method of implementing the Absolute Tolerance Concept by Sandia Corporation suppliers is to apply a reduction of the design specification limits in the amount of 3-sigma of the measuring system. The intent of this reduction is to assure that no more than 1 percent of the product accepted by inspection is nonconforming. It is shown, with the aid of statistical data and graphs, how the desired 1-percent level can be achieved with less than a 3-sigma reduction, (and, in some cases an increase) of the design specification limits. At the same time, the percentage of conforming product rejected by inspection will be greatly reduced, thus reducing the cost per accepted unit. (auth)

10688 (SC-TM-64-1668) GALVANOMETER SELECTION. G. A. Nigg (Sandia Corp., Albuquerque, N. Mex.). Nov. 1964. Contract AT(29-1)-789. 13p. Dep.(mn); $1.00(cy), 1(mn) OTS.

This report provides criteria and graphically presented data for selecting galvanometers. Also included is a discussion of galvanometer parameters which must be considered in selecting galvanometers. (auth)

10689 (SCL-DC-64-9) A MODULAR PRINTED CIRCUIT LABORATORY. E. E. Alford (Sandia Corp. Livermore Lab., Livermore, Calif.). Feb. 1964. Contract [AT(29-1)-789]. 12p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A compact, modular laboratory was developed for fabricating quality boards for development work on etched circuit boards. In the laboratory, all the operations except plating are carried out in a 20 ft × 20 ft area. (D.L.C.)

10690 (SCL-DR-64-105) CALIBRATION OF ACCELEROMETERS AT HIGH SHOCK LEVELS BY ACTION-REACTION MEASUREMENTS. K. D. Marx (Sandia Corp. Livermore Lab., Livermore, Calif.). Dec. 1964. Contract AT(29-1)-789. 14p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Action-reaction measurements obtained with a high-energy shock facility have been used to compute high shock levels. The computed values are compared with values read directly by accelerometers mounted on the facility and with values obtained in an independent study. There is apparent agreement between the three sets of data. (auth)

10691 (SCL-DR-64-113) DYNAMIC LOADING OF A CYLINDRICAL SHELL. C. W. Robinson (Sandia Corp. Livermore Lab., Livermore, Calif.). Jan. 1965. Contract AT(29-1)-789. 26p. Dep.(mn); $2.00(cy); 1(mn) OTS.

The equations of motion for a long cylindrical shell are solved for the case of a pressure load which varies independently with angle and time. The solution is obtained by superimposing two approximate solutions. Expressions for the stress and displacements are derived in series form, and insignificant terms of the series are eliminated. (auth)

10692 (SCL-DR-64-144) LOADS ON A CONICAL BODY IMPACTING SAND AND POLYURETHANE FOAM. W. E. Edelman and L. H. Bakken (Sandia Corp. Livermore Lab., Livermore, Calif.). Jan. 1965. Contract AT(29-1)-789. 41p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The peak loading on a rigid-body cone has been experimentally determined for base-first impact into sand and polyurethane foam at velocities from 10 fps to 250 fps. Also, limited test data for cone vertex-first and lateral impact orientations are presented. (auth)

10693 (SRO-109) SURVEY OF DIVERSIFICATION POTENTIAL AT SAVANNAH RIVER. (Savannah River Operations Office, AEC). Dec. 1964. 55p. Dep.(mn); $3.00(cy), 1(mn) OTS.

Results are reported from a survey of uses that can be made of existing facilities and people. The facilities comprise five large production reactors, two chemical separations plants for reprocessing irradiated nuclear fuel, a fuel fabrication plant, a heavy water plant, service facilities, and extensive research and development facilities. Among the isotopes that have been made at Savannah River, incidental to the production of tritium and plutonium-239, are plutonium-238, curium-244, polonium-210, cobalt-60, and uranium-233. Much larger quantities of these isotopes could be made very efficiently. Many other isotopes such as thulium-170, thulium-171, scandium-46, and thallium-204 can also be made. In fact, the synthesis of any isotope via neutron addition can be accomplished most efficiently in Savannah River reactors. There are approximately 5800 employees, about 5100 engaged in production activities and 700 involved in research and development with a total of 887 people with technical degrees in the fields of physics, metallurgy, chemistry, biology, engineering, and mathematics. Extensive laboratory facilities are available for work in nuclear technology. The principal capabilities and tools are in the fields of physics, metallurgy, chemistry, engineering, and mathematics. It was concluded that Savannah River has a broad capability for the production of isotopes and radiation sources and for the development and design of nuclear reactors, whether they be for isotope production, power, breeding, or desalination. This capability includes the design, testing, and fabrication of nuclear fuel and target assemblies. It also includes the development of the chemical processes and equipment for reprocessing the irradiated fuel and targets to recover nuclear materials and to dispose of radioactive waste. Several other uses of the facilities are discussed, including medical research, textile research, and the development of wood plastic alloys. (C.H.)

10694 (TID-3043(Rev.2)(Suppl.2)) BIBLIOGRAPHIES OF INTEREST TO THE ATOMIC ENERGY PROGRAM. Richard J. Smith, Hugh E. Voress, and Naomi K. Smelcer, comps. (Division of Technical Information Extension, AEC). Aug. 1964. 108p. Dep.; $4.00(OTS).

A total of 536 annotated references is given to bibliographies and literature surveys identified by the Division of Technical Information Extension, USAEC, as being of interest to the atomic energy program. References to report literature are arranged alphanumerically under the issuing organizations; published-literature citations are grouped separately. Subject, author, and report number and availability indexes are provided. (auth)

10695 (TID-20274) PHENYLKETONURIA. W. Eugene Knox (New England Deaconess Hospital. Cancer Research Inst., Boston). [Feb. 24, 1964]. Contract AT(30-1)-901. 94p. Dep.(mn); $3.00(cy), 2(mn) OTS.

A detailed review is presented of the knowledge of phenylketonuria as a basis for the future study of the mental defect in this disease. The incidence, age distribution, sex, and other characteristics of the disease are considered. Intelligence aspects, clinical features, biochemical abnormalities, metabolites, genetics, inheritance mode, and treatment are discussed. (D.L.C.)

10696 (TID-20342) CYSTINURIA. W. Eugene Knox (New England Deaconess Hospital. Cancer Research Inst., Boston). [Mar. 6, 1964]. Contract AT(30-1)-901. 56p. Dep.(mn); $3.00(cy), 1(mn) OTS.

Cystinuria is an inherited condition of man characterized by excessive appearance in the urine of cystine, lysine, arginine, and ornithine. No other amino acids are found in excessive amounts. Cystine tends to precipitate and form stones in the urinary passages, with pathological consequences. The etiology of cystinuria, the chemical properties of cystine, and the metabolism of cystine and other amino acids are discussed. (C.H.)

10697 (TID-20343) LATTICE PARAMETER MEASUREMENTS OF UNDOPED AND CHROMIUM-DOPED WUSTITE. Roger L. Levin and J. Bruce Wagner, Jr. (Northwestern Univ., Evanston, Ill. Technological Inst.). [1964]. Contract [AT(11-1)-1126]. 14p. Dep.(mn); $1.00 (cy), 1(mn) OTS.

Lattice parameter measurements have been carried out at room temperature on undoped and on chromium-doped wüstite as a function of oxygen concentration. Results may be expressed by a_0 (in Å) = 4.96296 − 2.81429 [wt fraction of oxygen] for the undoped wüstite. These data are in agreement with and extend the work of Jette and Foote. The present results are consistent with the cation vacancy model for metal deficit wüstite, both undoped and doped. (auth)

10698 (TID-20372) ELECTROPHORESIS OF MOUSE LIVER SUBFRACTIONS. G. Lew Choules and Robert Ballentine (Johns Hopkins Univ., Baltimore. McCollum-Pratt Inst.). [Jan. 15, 1964]. Contract AT(30-1)-1822. 26p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A high speed technique for zone electrophoresis using a density gradient apparatus was applied to mouse liver subfractions. For each experiment, a crude mitochondrial preparation was made from a single mouse liver by a simple differential centrifugation method, and the resulting preparation was subjected to electrophoresis. This preparation was composed principally of mitochondria and microsomes, with smaller numbers of lysosomes and other inclusions. Electrophoretic profiles of sample components were prepared by direct analysis of the resulting fractions. Analyses were performed for RNA, protein, light scatter ing, glucose-6-phosphatase, acid phosphatase, and cytochrome oxidase. These experiments show that mitochondria and microsomes from mouse liver do not separate during electrophoresis, but migrate as a single band having typical Gaussian symmetry. However, a particle-bound acid phosphatase fraction does separate from the main band. The biological significance of these results is discussed. (auth)

10699 (TID-20374) BUFFERED FIXATIVES SUITABLE FOR MOUSE LIVER MITOCHONDRIA. G. Lew Choules (Johns Hopkins Univ., Baltimore. McCollum-Pratt Inst.). [Jan. 15, 1964]. Contract AT(30-1)-1822. 13p. Dep.(mn); $1.00(cy), 1(mn) OTS.

As a by-product of investigations into the merits of various isolation media, several new buffered fixation mixtures were developed for use in electron microscope studies. These fixatives are more suitable for preserving the structure of subcellular particles than the more commonly used fixation media, which were developed for use with whole tissues. The results show that 0.02 $\underline{M}$ citrate (pH 6.2), histidine (pH 6.2–6.5), and imidazole (pH 7.0–7.5) prevent appreciable (pH alteration during isolation and fixation in the respective media containing these buffers and introduce far fewer particle aberrations than were previously obtained. The observations also indicate that if 0.2% bovine serum albumin is added to 0.22 $\underline{M}$ sucrose media, much longer lasting osmotic protection is obtained than that provided by 0.44 $\underline{M}$ sucrose alone. If the exposure time is kept short enough, comparably good results can be obtained with either of these osmotic buffering systems. (auth)

10700 (TID-21328) FRANKLIN INSTITUTE ANNUAL REPORT. (Franklin Inst. Labs. for Research and Development, Philadelphia). Nov. 27, 1964. Contract AT(30-1)-3347. 24p. Dep.(mn); $1.00(cy), 1(mn) OTS.

Gold films were deposited on glass near 80°K in high vacuum. X-ray measurements were made immediately after deposition as well as after annealing up to 300°C. Values for the twin fault densities, particle sizes, and strain were obtained. The presence of preferred orientations and grain growth during annealing was analyzed. (auth)

10701 (UCRL-7617-T) EXPANSION OF GEOPHYSICAL SCALAR FIELDS IN SURFACE SPHERICAL HARMONICS. Hugh W. Ellsaesser (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 5, 1963. Contract W-7405-eng-48. 49p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The properties of orthogonal functions and Fourier series are reviewed briefly and used as background for surveying methods of expanding functions known only at discrete points in surface spherical harmonic or Laplace series. The Gaussian, Shuster and Neumann methods of computing the series coefficients are described. Successful results in applying the Neumann general method to hemispheric meteorological data using an IBM 7094 computer are discussed briefly. (auth)

10702 (UCRL-7652-T) ON COMPLETE SETS OF LOGIC PRIMITIVES. Herschel H. Loomis, Jr., and Robert H. Wyman, Jr. (California. Univ., Livermore. Lawrence Radiation Lab.). Dec. 18, 1963. Contract W-7405-eng-48. 16p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A complete set of logic primitives is a set of devices that can be connected to represent any Boolean function of Boolean variables, for example diode AND and OR gates and transistor inverters. The addition of a delay or storage device to a complete set of logic primitives yields a set of devices from which any finite-state machine can be constructed. A problem of the number of devices required in a complete set of logic primitives is dealt with. A complete set of logic primitives may contain as few as one element, e.g., NOR. A least upper bound on the number of non-redundant elements in a complete set is sought. It is shown that every complete set contains a complete subset with at most four elements. Further, a complete set with four elements is produced, which is incomplete if any element is deleted. (auth)

10703 (UCRL-7680) FURTHER COMMENTS ON RECEIVING APERTURE WIDTHS IN SINGLE-CRYSTAL DIFFRACTOMETRY. Gordon S. Smith (California. Univ., Livermore. Lawrence Radiation Lab.) and Leroy E. Alexander (Mellon Inst., Pittsburgh). Feb. 4, 1964. Contract W-7405-eng-48. 4p. Dep.(mn); $1.00(cy), 1(mn) OTS.

It is shown that the equations of Ladell and Spielberg for the minimum aperture widths are incorrect. The correct equations are, for the 2θ scan, $\underline{R}_{\underline{x}}\gamma_{\underline{R}} = 4\underline{r}\sin\theta\,[(1 - (\underline{r}^2/\underline{R}_{\underline{x}}^2)\cos^2\theta)/(1 - \underline{r}^2/\underline{R}_{\underline{x}}^2)]^{1/2}$, and for the ω scan, $\underline{R}_{\underline{x}}\gamma_{\underline{R}} = 4\underline{r}\cos\theta\,[(1 - (\underline{r}^2/\underline{R}_{\underline{x}}^2)\sin^2\theta)/(1 - \underline{r}^2/\underline{R}_{\underline{x}}^2)]^{1/2}$. (D.L.C.)

10704 (UCRL-7681) A "PROGRESSIVE" INTERPOLATION SCHEME FOR HAND AND DIGITAL COMPUTER ANALYSIS OF TABULATED DATA. Michael D. Mintz and Duane P. Jordan (California. Univ., Livermore. Lawrence Radiation Lab.). Feb. 5, 1964. Contract W-7405-eng-48. 15p. Dep.(mn); $1.00(cy), 1(mn) OTS.

A four-point interpolation procedure is presented which, when applied to tabulated information, preserves both the data (i.e., no data smoothing) and the continuity of the first derivative. Consistent relationships are also presented for the "derivative" and "integral" of the data, and treatment of the tabular "end points" is discussed. (auth)

10705 (UCRL-7822) LAGRANGIAN ADVECTION IN AN ATMOSPHERIC MODEL. Cecil E. Leith (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 1964. Contract W-7405-eng-48. 11p. (CONF-640605-1). Dep.(mn); $1.00(cy), 1(mn) OTS.

From WMO/IUGG Symposium on the Research and Development Aspects of Long Range Forecasting, Boulder, Colo.

In a numerical model that approximates by finite difference equations the hydrodynamic and thermodynamic laws appropriate to a three-dimensional global moist atmosphere, an important problem is the evaluation of advection terms for heat, momentum, and moisture. A Lagrangian approach to this problem is described for one space dimension. This approach is extended to multidimensional problems through the method of fractional time steps. (auth)

10706 (UCRL-11763) REACTIONS OF ACTIVE NITROGEN WITH SULFUR COMPOUNDS (thesis). Jerry J. Smith (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Jan. 1965. Contract W-7405-eng-48. 74p. Dep. (mn); $7.60(fs), $2.42(mf) OTS.

The reactions of active nitrogen (nitrogen atoms) with several sulfur compounds were investigated to determine the feasibility of their use in preparing sulfur-nitrogen compounds. The mechanism and kinetics of the reaction with S_2Cl_2 were studied in detail. Reactions of nitrogen atoms with compounds having internal sulfur atoms (SCl_2, H_2S, and S_8 vapor) and with CS_2 and OCS were also studied. (D.L.C.)

10707 (UCRL-11786) THE KARYOTYPE OF THE DOG (CANIS FAMILIARIS) OBTAINED FROM CULTURES OF PERIPHERAL BLOOD LYMPHOCYTES (thesis). William D. Loughman (California. Univ., Berkeley. Lawrence Radiation Lab.). Nov. 1964. Contract W-7405-eng-48. 47p. Dep.(mn); $2.00(cy), 1(mn) OTS.

The canine modal chromosome number of 78 was confirmed by studies on eight identifiable dog breeds, one of which was purebred, and 19 mongrels. Karyotypes are presented for male and female mongrel dogs and details of chromosome morphology are included for 5 different chromosomes. An improved culture method for the routine culture of canine peripheral blood lymphocytes and a method for producing high quality air-dried chromosome preparations for microscopic examination are described. (C.H.)

10708 (UCRL-12185) A NOTE ON SURFACE WAVES ON A SLOPING BEACH. K. S. Yee (California. Univ., Livermore. Lawrence Radiation Lab.). Nov. 10, 1964. Contract W-7405-eng-48. 8p. Dep.(mn); $1.00(cy), 1(mn) OTS.

It is shown that some results of water waves on a sloping beach based on the linearized shallow water theory [Stoker (1947)] can be derived from the integral representations of the complex velocity potentials by Friedrichs (1948). (auth)

10709 (EURAEC-1186) SELECTIVE ATTACK, BY POTENTIOSTAT, OF THE PHASES EXISTING IN A TWO-PHASE STAINLESS STEEL. M. Cunha Belo, Ph. Berge, and J. Montuelle. Translated from Compt. Rend., 258: 570-3(Jan. 13, 1964). Work Performed under United States–Euratom Joint Research and Development Program. 5p. Dep.(mn); $1.10(fs), $0.80(mf) JCL.

A selective attack of the body-centered cubic phase existing in the Fe–Cr–Ni solid solution is suggested. The great sensitivity of this attack could be applied to the detection of small amounts of alpha phase in stainless steels. (auth)

10710 (FTD-MT-64-64) HERALD OF LENINGRAD UNIVERSITY. PHYSICS AND CHEMISTRY SERIES. Translation of Vestnik Leningradskogo Universiteta, Seriya Fiziki i Khimii, No. 1, 1-186(1963). 279p. (AD-608453). $6.00(OTS).

Twenty-five papers are presented on the following topics: symmetry of elementary particles, formation of more than two particles, Frenkel's excitons in CuO crystal, quantum theory, surface potential changes in PbS layers during illumination, isotopic analysis by emission spectra of molecules, spectral-isotopic detection of oxygen in metals, compensation of magnetic field inhomogeneity in a nuclear magnetic resonance spectrometer, the eclipse effect in the ozone region of the solar spectrum, ion-exchange theory of the glass electrode, galvanic cells with ion-exchange membranes, and electrode properties and stability of glasses. An abstract was prepared for the paper dealing with the spectral-isotopic detection of oxygen in metals. For abstracts of the two papers on isotopic analysis by emission spectra of molecules and on compensation of magnetic field inhomogeneity in a nuclear magnetic resonance spectrometer, see NSA 17: 32023 and 32367. (D.L.C.)

For an abstract of the individual paper see: 9065.

10711 THE FRENCH ATOMIC PROGRAM. H. de Laboulaye (Commissariat a l'Energie Atomique, Paris). Euratom Bull., 3: No. 4, 3-11(Dec. 1964).

The design and construction of power plants and armaments are surveyed. Production studies and production of basic nuclear materials—U, ^{235}U, Pu, heavy water—are discussed. Radioisotope production and uses are described. Programs in basic and long-term research are reviewed, and work on radiological protection and nuclear safety is mentioned. Tables are given of characteristics of planned and operational reactors, and the economics of the CEA programs are considered. (M.J.T.)

10712 THE DILEMMA OF POWER: NUCLEAR WEAPONS AND HUMAN RELIABILITY. Paul F. Eggertsen (Armed Forces Inst. of Pathology, Washington, D. C.). Psychiatry, 27: 211-18(Aug. 1964).

Safety in the control and handling of nuclear weapons is discussed. The recommendations of several committees which have examined aspects of human behavior in relation to nuclear weapons control are also discussed. Data were accumulated on a large number of nonnuclear destructive acts, both intentional and accidental. Data on near-accidents or unsafe situations were also gathered and studied intensively. In other studies, age and rank were plotted against the rates of various diagnoses, suicides, accidents, and behavioral incidents. The age group from 20 to 38 was found to be relatively free from the kind of serious psychiatric problem which might tend toward accidental or deliberate nuclear detonation. Incidents that indicated possible danger were collected and studied, visits were made to many installations where nuclear weapons were stored, repaired, and deployed, and consultation was offered. It appears that any program depends upon education. The preparation of a manual to be used by military commanders in selecting safe personnel for key positions is described. (BBB)

10713 INTERNATIONAL IMPACT OF NUCLEAR POWER. Raymond L. Murray (North Carolina State Univ., Raleigh). 11p. (CONF-714-3)

From Conference on Nuclear Education in the New Era of Nuclear Power, Gatlinburg, Tenn., Aug. 1964.

The aims and accomplishments of the Atoms for Peace program are reviewed and the future of nuclear energy abroad is evaluated. The opportunities and responsibilities of educators in the international program are discussed. (H.D.R.)

10714 METHOD OF BRAZING. P. Patriarca and G. M. Slaughter (to U. S. Atomic Energy Commission). U. S. Patent 3,164,897. Jan. 12, 1965.

A method of joining metal articles using a brazing alloy of Ni, P, and Cr is described. Ni and P are first deposited from an electroless plating solution onto the surfaces to be joined and then Cr is electroplated over the Ni–P layer. The resulting coated surfaces, in contact with each other, are then heated to about 1800°C. (AEC)

10715 METHOD OF APPLYING LAMB WAVES IN ULTRASONIC TESTING. Daniel C. Worlton (to U. S. Atomic Energy Commission). U. S. Patent 3,165,922. Jan. 19, 1965.

A method of detecting sub-surface flaws in metal samples is described. The method comprises the steps of generating ultrasonic plane waves and refracting these waves to generate a spectrum of angles. The refracted ultrasonic waves are caused to impinge on the surface of the metal sample, whereby they excite Lamb wave modes within the sample in the presence of subsurface flaws. The excited Lamb wave modes are detected, from which the presence of subsurface flaws in the metal sample is determined. (AEC)

10716 SEALING MEANS. D. W. Hall and B. D. Troyer (to U. S. Atomic Energy Commission). U. S. Patent 3,166,133. Jan. 19, 1965.

A sealing device which utilizes a liquid barrier seal for isolating atmospheres on opposite sides of the barrier while facilitating frictionless force transmission through it is described. The separated atmospheres may be those of a dry box and a room which contains the dry box. An annular cup with an inverted cup inside provides a pair of volumes in registry with each other through a passageway at the lower end of the inverted cup. The passageway and portions of the volumes are filled with the liquid seal. Force transmission is attained by a U-shaped rod disposed in the volumes and through the passageway with the rod being vertically movable to provide the force transmission. The force transmission through the liquid barrier is unaffected by pressure differentials which may exist across the seal due to a balancing of the volumes on opposite sides of the inverted cup. (AEC)

10717 APPARATUS FOR WEIGHING MATERIAL IN A SEALED ENCLOSURE. Raphael T. Coffman (to U. S. Atomic Energy Commission). U. S. Patent 3,166,136. Jan. 19, 1965.

A seal and a force transmitter is described that enables a mass in a sealed compartment to be weighed accurately by a weighing apparatus located outside the compartment, in spite of variable pressure differences between the sealed compartment and its exterior. The force transmitter, which operates between the mass to be weighed and the weighing apparatus, has a part that extends transversely to the direction of movement of the weighing apparatus. A bellows seal loosely contains the transversely extending part of the force transmitter. (AEC)

10718 RESPIRATOR WITH POSITIVE AIR SEAL. L. Silverman (to U. S. Atomic Energy Commission). U. S. Patent 3,167,070. Jan. 26, 1965.

A combination gas mask and respirator, in which the wearer is assisted in his breathing through the mask by an air-supplied peripheral sealing chamber, is described. The peripheral chamber is formed with the face as one wall and a porous outer wall insures good contact against the face. A substantial portion of the sealing air passes into the mask proper where it is mixed and breathed by the wearer. The reduced air requirement for this mask renders it very suitable for portable use. (AEC)

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ö oe
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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium—isotopes He-4 or Helium—He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid—methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
  Al–Cr . . .
CHROMIUM ALLOYS
  Al–Cr . . .

Well-known alloys such as Hastelloy are indexed directly. Cross references appear in the index cumulations. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
  Si–W . . .
TUNGSTEN SYSTEMS
  Si–W . . .

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

Specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Whenever it appears that such information would be useful, descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract. Such phrases are written so that the idea considered most important is presented first. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

For entries concerned with physics, if the modifier does not indicate whether the reference is experimental or theoretical, a symbol E or T or E/T is given.

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CERN European Organization for Nuclear Research. Available without charge from CERN European Organization for Nuclear Research, Geneva 23, Switzerland. Copies are deposited in libraries in 13 countries.

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TURKEY

Turkish Atomic Energy Commission. Copies are available free of charge from T.A.E.C., Çekmece Nuclear Research Center, P. O. Box 1, Airport, İstanbul, Turkey.

UNITED KINGDOM

United Kingdom Atomic Energy Authority. Some reports are for sale in the United States by the British Information Service (BIS), 845 Third Avenue, New York, N. Y. 10022. United Kingdom reports generally may be purchased from Her Majesty's Stationery Office, London. Copies not for sale by Her Majesty's Stationery Office may be purchased in microcopy form from Micro Methods Limited, East Ardsley, Wakefield, Yorks, England. Report copies are deposited in a large number of libraries in England.

Conferences

Beginning with Volume 19, Number 1, new receipts of conference proceedings as well as individual papers from conferences will be included in this index. When a paper is received from a conference a distinctive number will be assigned to the conference in the form CONF-year-month-sequence. Individual papers will be numbered with this basic "CONF" number and in addition each will carry a further sequence number. For example, the first paper received from a conference held in January 1965 would be numbered CONF-650101-1. Conference proceeding from which no individual papers have been received will be similarly numbered with a basic number. When proceedings are abstracted the abstract will appear at the point of the basic "CONF" number for the conference. Since all information on conferences will be included in this Report Number Index the subject heading CONFERENCES will be discontinued with Volume 19, Number 1.

Abbreviations Used in Availability Column

AECL	For sale by Atomic Energy of Canada Ltd., Chalk River, Ontario, Canada.
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DTI Extension	Available from the U. S. Atomic Energy Commission, Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831.
EM	Blueprints and Microcopy of AEC engineering drawings are available from Clearinghouse for Federal Scientific and Technical Information, U. S. Department of Commerce, Springfield, Virginia 22151. Current prices of the CAPE- packages may be obtained from this address. TID-4100, available from the Division of Technical Information Extension, P. O. Box 62, Oak Ridge, Tennessee 37831, contains information on all the CAPE- packages for sale.
Gmelin	Available at a nominal charge and under the AED- number shown from Atomic Energy Documentation Center, Gmelin Institute, 40-42 Varrentrappstrasse, Frankfurt (Main), West Germany.
GPO	For sale by the Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.
HMSO	Her Majesty's Stationery Office, London.
IAEA	Available from the International Atomic Energy Agency.
JCL	For sale by the Special Libraries Association Translation Center, John Crerar Library, 35 West 33rd Street, Chicago, Illinois 60616.
LC	For sale by the Library of Congress, Photoduplication Service, Washington, D. C. 20540.

NAS	National Academy of Sciences, National Research Council, Washington, D. C. 20418.
NRC	For sale by the National Research Council of Canada, Ottawa, Ontario, Canada.
ORINS	Available on interlibrary loan from the Library, Oak Ridge Institute of Nuclear Studies, Post Office Box 117, Oak Ridge, Tennessee 37831.
OTS	For sale by the Clearinghouse for Federal Scientific and Technical Information, U.S. Department of Commerce, Springfield, Virginia 22151. The symbol "cy" indicates that the format of the item sold may be either a printed document or a photographic reproduction (two-thirds of original size) depending upon the availability of printed stock. The indicated price is for either format. The symbol "mn" is used to indicate the fact that copy is available in the form of micronegatives (microfiche). The number preceding the "mn" symbol indicates the number of micronegatives in the set. Micronegatives are available at the following prices: One micronegative, $0.50; each additional micronegative of the set, $0.25. For additional micronegative copies of the same report requested at the time of the original order, $0.25 per micronegative. Prices are reduced on micronegatives if subscription distribution is purchased.
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Report No.	Abstract No.	Availability
A/CONF.28/P–	**(3rd. U. N. Int. Conf. on Peaceful Uses of Atomic Energy)**	
261	19-9768	For full version see LAMS-3079
AAEC/TM–	**(Australian)**	
271	19-9641	Dep.(mn)
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64015	19-10528	Dep.(mn); $4.00(cy), 3(mn) OTS
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AD–	**(Misc.)**	
420048	19-9735	See NRL-Memo-1424
420255	19-9885	See KN-674-63-7(R)
420544	19-9763	See ARL-63-195
420545	19-9764	See ARL-63-196
420825	19-9364	$4.60(OTS)
421181	19-10377	$7.60(OTS)
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421896	19-9959	$10.50(OTS)
422319	19-9402	$17.50(OTS)
422394	19-8781	$9.60(OTS)
422399	19-9328	See IRD-63-82
424129	19-10382	See AFCRL-63-899
425474	19-9597	See DMIC-193
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442907	19-9384	
443485	19-9944	OTS
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444557	19-10158	See AFCRL-64-204(Vol.3)
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601585	19-9756	See TO-B-64-10
601792	19-8795	See SAM-TDR-64-29
601838	19-8952	$0.50(OTS)
602142	19-9452	See USAELRDL-TR-2456
602358	19-9762	See AID-P-64-44
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602470	19-9760	$1.00(OTS)
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602764	19-9289	See WL-TDR-64-53
602850	19-9355	See HI-361-RR/2
602854	19-9350	$1.00(OTS)
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602947	19-9403	$7.31(OTS)
602970	19-9761	See AFCRL-64-534
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603058	19-9660	See ML-TDR-64-166
603067	19-9644	$1.00(OTS)
603068	19-9351	$5.00(OTS)
603097	19-10395	See NSL-62-105-5
603100	19-9354	See GDC-64-026
603158	19-9353	See ESD-TDR-64-134
603227	19-9352	$5.00(OTS)
603229	19-9544	$3.00(OTS)
603603	19-10221	See GNE/Phys/64-7
603605	19-9167	See GNE/Phys/64-2
603606	19-9733	See GNE-Phys/64-1
603610	19-10542	See GNE/Phys/64-10
603614	19-10616	See GNE/Phys-64-14
603652	19-9320	$3.00(OTS)
603779	19-9592	See ASD-8-170(IV)
603790	19-9946	See ASE-546
603883	19-10454	See P-157(RAND)
603901	19-10379	$1.00(OTS)
603928	19-9490	See SGC-406R-2
604040	19-10162	See SEL-63-110
604069	19-10161	See RM61TMP-33
604087	19-10383	See AL-TDR-64-157
604120	19-10397	See RADC-TDR-64-174
604335	19-9545	See AL-TDR-64-112
604423	19-9608	See ML-TDR-64-81
604685	19-9609	See ML-TDR-64-83
604738	19-9607	See ML-TDR-64-70
604867	19-9645	$2.00(OTS)
604872	19-9646	$2.00(OTS)
604876	19-9647	$1.00(OTS)
606826	19-9321	$3.00(OTS)
607518	19-9965	See MHD-660
607784	19-9960	$2.00(OTS)
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608093	19-10396	See R64SD-70
608343	19-9619	See AMRA-TR-64-33
608445	19-10189	See RLE-TR-427
608453	19-10710	For translation see FTD-MT-64-64
608494	19-10159	See AFCRL-64-809
608497	19-9636	See NMI-9700-24
608737	19-9648	$2.00(OTS)
608738	19-9649	$4.00(OTS)
608818	19-9629	$6.00(OTS)
609049	19-10451	$2.00(OTS)
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609554	19-9651	See AMRA-TR-64-28
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64-410	19-9962	$2.00(OTS)
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64-487	19-9945	$2.00(OTS)
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AFOSR-TDR–	**(Non-AEC)**	
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AGARDograph–	**(Non-AEC)**	
84	19-9795	See CONF-752(Pt.I)
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68	19-9612	Dep.(mn); $1.10(fs), $0.80(mf) JCL
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6828	19-10604	Dep.; $3.00(OTS)
6903	19-9474	Dep.; $1.00(OTS)
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6934	19-9300	Dep.; $2.00(OTS)
6935	19-10635	Dep.; $2.00(OTS)
6966	19-9301	Dep.; $1.00(OTS)
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4533	19-10637	
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63-195	19-9763	$1.60(OTS)
63-196	19-9764	$1.60(OTS)
64-151	19-9727	OTS
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8-170(IV)	19-9592	$3.00(OTS)
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7949	19-10591	Nucl. Sci. Eng., 21: 165-78(1965)
8054	19-9161	J. Org. Chem., 29: 3086(1964)
8115	19-10230	Nucl. Sci. Eng., 21: 227-39(1965)
8256	19-9864	J. Geophys. Res., 70: 215-24(1965)
8453	19-9863	J. Geophys. Res., 70: 209-13(1965)
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8703	19-9437	Dep.(mn); $2.00(cy), 1(mn) OTS
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864-15521R	19-10469	See NASA-CR-54204
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2498	19-9302	Dep.(mn)
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2579	19-9630	Dep.(mn)
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2588	19-9740	For translation see EURAEC-1094
2602	19-9670	For translation see AI-Trans-69
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A-1715	19-9497	Dep.(mn); $1.60(fs), $0.80(mf) JCL
X-585	19-9064	Dep.(mn); $2.60(fs), $0.89(mf) JCL
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64-47	19-10452	Dep.(mn)
64-50	19-9303	Dep.(mn)
64-51	19-9574	Dep.(mn)
CLM-R–	**(British)**	
41	19-10385	Dep.; $0.50(BIS), 2s. 6d. (HMSO)
CONF-67–	**(Health Physics Society 8th Annual Meeting, New York, June 1963)**	
29	19-9414	See AEEW-R-265
CONF-83–	**(International URSI Conference, Tokyo, Sept. 1963)**	
2	19-10384	See CEA-R-2427
CONF-193–	**(8th Nuclear Congress, Rome, June 1963)**	
10	19-10489	See RT/FI(64)-19
CONF-217–	**(Radiation Research Society 11th Annual Meeting, Milwaukee, May 1963)**	
3	19-8951	ORINS
CONF-407–	**(Electro Chemical Society, Toronto, May 1964)**	
10	19-9058	See EUR-2156.e
CONF-446–	**(American Nuclear Society 10th Annual Meeting, Philadelphia, June 1964)**	
68	19-9344	ORINS. Gmelin, AED-CONF-64-081-102
73	19-10597	ORINS. Gmelin, AED-CONF-64-081-105
75	19-10598	ORINS. Gmelin, AED-CONF-64-081-97
76	19-9565	ORINS. Gmelin, AED-CONF-64-081-98
CONF-471–	**(American Physical Society 5th Annual Meeting, San Diego, Calif., Nov. 1963)**	
45	19-10386	$1.00(cy), 1(mn) OTS; AED-CONF-63-268-3
CONF-512–	**(American Society for Testing and Materials 67th Annual Meeting, Chicago, June 1964)**	
12	19-9429	ORINS. Gmelin, AED-CONF-64-118-1
15	19-9731	See GA-5273
CONF-522–	**(Annual Meeting of the Aerospace Medical Association,**	

Report No.	Abstract No.	Availability
	Miami, Fla., May 1964)	
3	19-9560	ORINS. Gmelin, AED-CONF-64-061-2
CONF-538	**(23rd Annual Conference on Physical Electronics, Cambridge, Mass., Mar. 1963)**	
2	19-9970	ORINS
CONF-543–	**(American Physical Society 1964 March Meeting, Philadelphia, Mar. 1964)**	
9	19-9241	ORINS. Gmelin, AED-CONF-64-028-24
14	19-10215	ORINS. Gmelin, AED-CONF-64-028-30
CONF-546–	**(Conference on Analytical Chemistry and Applied Spectroscopy, Pittsburgh, Mar. 1964)**	
3	19-9048	See SC-DC-64-380
CONF-553–	**(American Ceramic Society 66th Annual Meeting Including Symposium on Nuclear and Space Applications, Chicago, Apr. 1964)**	
10	19-9725	ORINS. Gmelin, AED-64-048-13
11	19-9726	ORINS. Gmelin, AED-CONF-64-048-14
CONF-554–	**(Cryogenic Engineering Conference, Philadelphia, Aug. 1964)**	
13	19-10449	ORINS. Gmelin, AED-CONF-64-142-6
CONF-555–	**(International Symposium on Surface Contamination, Gatlinburg, Tenn., June 1964)**	
6	19-9759	ORINS. Gmelin, AED-CONF-64-083-5
12	19-9428	ORINS. Gmelin, AED-CONF-64-083-14
13	19-9430	ORINS. Gmelin, AED-CONF-64-083-10
CONF-603–	**(Transaction of Meeting, Vacuum Metallurgy, American Vacuum Society, New York, June–July 1964)**	
8	19-9465	ORINS. Gmelin, AED-CONF-64-109-8
CONF-606–	**(American Chemical Society, Northwest Regional Meeting, Spokane, Wash., June 1964)**	
4	19-9277	ORINS. Gmelin, AED-CONF-64-112-9
CONF-630–	**(Conference on Non-Linear Processes in the Ionosphere, Boulder, Colo., Dec. 1963)**	
4	19-10187	ORINS. Gmelin, AED-CONF-63-274-4
5	19-10188	ORINS. Gmelin, AED-CONF-63-274-5
CONF-637–	**(Institute of Electrical and Electronics Engineers Region 3 Annual Meeting and Technical Conference, Clearwater, Fla., May 1964)**	
9	19-10448	ORINS. Gmelin, AED-CONF-64-057-15
CONF-642–	**(Health Physics Society, Cincinnati, June 1964)**	
2	19-10666	ORINS. Gmelin, AED-CONF-64-082-12
3	19-10632	ORINS. Gmelin, AED-CONF-64-082-13
12	19-9432	ORINS. Gmelin, AED-CONF-64-082-48
13	19-10600	ORINS. Gmelin, AED-CONF-64-082-42
14	19-9431	ORINS. Gmelin, AED-CONF-64-082-38
15	19-9433	ORINS. Gmelin, AED-CONF-64-082-19
17	19-8779	ORINS. Gmelin, AED-CONF-64-082-43
22	19-8780	ORINS. Gmelin, AED-CONF-64-082-26
CONF-649–	**(12th Annual Conference on Mass Spectrometry and Applied Topics, Montreal, June 1964)**	
10	19-9941	ORINS. Gmelin, AED-CONF-64-093-9
16	19-9464	ORINS. Gmelin, AED-CONF-64-093-22
18	19-9466	ORINS. Gmelin, AED-CONF-64-093-16
22	19-9463	ORINS. Gmelin, AED-CONF-64-093-25
25	19-9943	ORINS. Gmelin, AED-CONF-64-153-1
CONF-650–	**(Linear Accelerator Conference, Madison, Wis., July 1964)**	
8	19-9832	ORINS. Gmelin, AED-CONF-64-143-3
10	19-9830	ORINS. Gmelin, AED-CONF-64-143-5
11	19-9831	ORINS. Gmelin, AED-CONF-64-143-4
CONF-650102–	**(Highway Research Board 44th Annual Meeting, Washington, D. C., Jan. 11–15, 1965)**	
1	19-9295	See UCRL-12248
CONF-650302–	**(IAEA Symposium on Personnel Dosimetry for Accidental High-level Exposure to External and Internal Radiation, Vienna, Mar. 1965)**	

Report No.	Abstract No.	Availability
1	19-9477	Dep.(mn); $1.00(cy), 1(mn) OTS
CONF-651–	**(9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug. 31–Sept. 4, 1964)**	
37	19-10214	ORINS. Gmelin, AED-CONF-64-140-37
39	19-10216	ORINS. Gmelin, AED-CONF-64-140-41
CONF-654–	**19-2907** **19-6030**	**(American Nuclear Society Meeting, San Francisco, Nov. 30–Dec. 3, 1964)**
24	19-10219	Dep.(mn); $1.00(cy), 1(mn) OTS
28	19-9314	See WAPD-T-1689
30	19-10223	See WAPD-T-1734
CONF-657–	**(4th Annual Photovoltaic Specialists Conference, Cleveland, June 1964)**	
4	19-9550	ORINS. Gmelin, AED-CONF-64-087-7
CONF-662–	**(24th National Convention of Society for Nondestructive Testing, Philadelphia, Oct. 1964)**	
2	19-9347	See HW-SA-3400
CONF-714–	**(Conference on Nuclear Education in the New Era of Nuclear Power, Gatlinburg, Tenn., Aug. 24–25, 1964)**	
2	19-10699	ORINS. Gmelin, AED-CONF-64-144-1
3	19-10713	ORINS. Gmelin, AED-CONF-64-144-2
CONF-720–	**(2nd Symposium on Protection Against Radiation Hazards in Space, Gatlinburg, Oct. 1964)**	
3	19-9492	See UCRL-10980(Rev.)
CONF-727–	**(10th Annual Bioassay and Analytical Chemistry Meeting, Cincinnati, Oct. 1964)**	
4	19-8724	See NLCO-933
CONF-742–	**(15th CITCE Meeting (Internat'l Comm. on Thermodynamics and Electrochemical Kinetics), London, England, Sept. 20–26, 1964)**	
3	19-9096	See ORNL-P-403
CONF-751–	**(Joint Eastern and Western Simulation Council Meeting, Pittsburgh, Pa., June 8–9, 1964)**	
2	19-9584	See WAPD-T-1700
CONF-752–	**(22nd Meeting of the Supersonic Tunnel Assoc. at the von Karman Institute for Fluid Dynamics, Rhode-Saint-Genese, Belgium, Sept. 24–25, 1964)**	
(Pt.I)	19-9795	Arc Heaters and MHD Accelerators for Aerodynamic Purposes. Part I. (North Atlantic Treaty Organization, Paris. Advisory Group for Aeronautical Research and Development). Sept. 1964
CONF-763–	**(American Society of Mechanical Engineers Winter Meeting, New York, Nov. 29–Dec. 4, 1964)**	
43	19-9288	See WAPD-T-1636
CONF-765–	**(2nd Conference on Radioactive Fallout from Nuclear Weapons Tests, Germantown, Md., Nov. 3–6, 1964)**	
7	19-8737	See BNL-8657
CONF-773–	**(Symposium on Chemical Effects Associated with Nuclear Reactions and Radioactive Transformation, Vienna, Dec. 1964)**	
6	19-10515	See HW-SA-3772
7	19-9165	See COO-32-105
8	19-9166	See COO-32-106
CONF-778–	**(Metals/Materials Congress, Philadelphia, Oct. 1964)**	
4	19-9666	See UCRL-11687
CONF-799–	**(11th Annual Nuclear Science Symposium, Philadelphia, Oct. 28–30, 1964)**	
7	19-9494	See UCRL-11738
10	19-9493	See UCRL-11517
11	19-9488	See PPAD-529-E
CONF-804–	**(Symposium on the Inelastic Scattering of Neutrons, Bombay, Dec. 15–19, 1964)**	
2	19-9659	See LA-DC-6594

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CONF-813–	**(10th Annual and First International Meeting of the Western Section of the Operations Research Society of America, Honolulu, Sept. 14–18, 1964)**	
1	19-8784	Dep.(mn); $2.00(cy), 1(mn) OTS
CONF-620901–	**(9th Congress of the International Society of Hematology, Mexico City, Sept. 17–23, 1962)**	
(Vol.1)	19-8733	Proc. Intern. Congr. Hematol., 9th, Mexico City, 1962, 1: 1-751(1964)
CONF-630901–	19-9798	**(12th Ampere Colloquium, Bordeaux, Sept. 17–21, 1963)**
CONF-631102–	**(Aerospace Materials Conference, Los Angeles, Nov. 11, 1963)**	
1	19-9665	See UCRL-11067
CONF-631103–	**(IVth Italian Symposium on Electron Microscopy, Padua, Nov. 25–26, 1963)**	
1	19-9655	See EURAEC-1260
CONF-640605	**(WMO/IUGG Symposium on the Research and Development Aspects of Long Range Forecasting, Boulder, Colo., June–July 1964)**	
1	19-10705	See UCRL-7822
CONF-640606–	**(American Physical Society Summer Meeting, Denver, Colo., June 25–27, 1964)**	
3	19-9567	Dep.(mn); $1.00(cy), 1(mn) OTS; Gmelin, AED-CONF-64-113-27
CONF-640701–	**(International Symposium on Magnetohydrodynamic Electrical Power Generation, Paris, July 6–11, 1964)**	
17	19-9972	ORINS
18	19-9969	ORINS
19	19-9977	ORINS
20	19-9973	ORINS
21	19-9976	ORINS
22	19-9968	ORINS
23	19-9975	ORINS
24	19-9971	ORINS
25	19-9974	ORINS
29	19-10447	ORINS
30	19-9984	ORINS
31	19-9980	ORINS
32	19-9994	ORINS
33	19-9978	ORINS
34	19-9981	ORINS
36	19-9983	ORINS
37	19-9979	ORINS
38	19-9982	ORINS
39	19-9997	ORINS
42	19-9999	ORINS
43	19-9996	ORINS
44	19-9995	ORINS
45	19-10004	ORINS
49	19-9998	ORINS
54	19-9990	ORINS
55	19-9985	ORINS
64	19-9804	ORINS
66	19-10442	ORINS
68	19-9942	ORINS
69	19-9802	ORINS
70	19-9803	ORINS
71	19-10440	ORINS
72	19-10441	ORINS
73	19-9993	ORINS
74	19-9992	ORINS
75	19-9991	ORINS
76	19-10003	ORINS
77	19-9628	ORINS
79	19-9292	ORINS
80	19-9627	ORINS
81	19-9724	ORINS
83	19-10443	ORINS
84	19-9349	ORINS
85	19-9989	ORINS
86	19-9987	ORINS
87	19-10001	ORINS
88	19-10002	ORINS
89	19-10000	ORINS
90	19-9799	ORINS
96	19-10445	ORINS
99	19-10444	ORINS
101	19-9801	ORINS
102	19-9800	ORINS
105	19-10446	ORINS
111	19-9986	ORINS
112	19-9988	ORINS
CONF-640702–	**(American Crystallographic Assn. Annual Meeting, Bozeman, Mont., July 26–31, 1964)**	
3	19-9929	Rev. Sci. Instr., 36: 196-7(1965)
CONF-640901–	**(3rd Biennial Aerospace Power Systems Conference, Philadelphia, Sept. 1–4, 1964)**	
1	19-10633	ORINS
2	19-10631	ORINS
3	19-9564	ORINS
4	19-10008	ORINS
5	19-10009	ORINS
6	19-10013	ORINS
8	19-10006	ORINS
9	19-9319	ORINS
10	19-10005	ORINS
11	19-10007	ORINS
13	19-10010	ORINS
14	19-10011	ORINS
15	19-10012	ORINS
CONF-640902–	**(3rd International Measurement Conference, Stockholm, Sept. 14–19, 1964)**	
1	19-9245	Acta IMEKO, 439-52(1964)
4	19-9559	Acta IMEKO, 427-37(1964)
5	19-9246	Acta IMEKO, 453-63(1964)
CONF-640903–	**(American Vacuum Society Symposium, Chicago, Sept. 30–Oct. 2, 1964)**	
2	19-9359	See ORNL-P-818
CONF-640904–	**(Tripartite Technical Cooperation Program Panel N-1 Sub-group N., Toronto, Sept. 28–30, 1964)**	
1	19-8783	See BNL-8571
CONF-641001–	**(Symposium on Radiochemical Methods of Analysis, Salzburg, Austria, Oct. 19–23, 1964)**	
14	19-9434	ORINS
44	19-9561	ORINS
CONF-641103–	**(Air Pollution Control Assn. Annual Meeting, Northwest Section, Portland, Oreg., Nov. 5–6, 1964)**	
1	19-10546	See HW-SA-3683
CONF-641104–	**(Soil Science Society of America Annual Meeting, Kansas City, Mo., Nov. 19, 1964)**	
1	19-9361	See HW-SA-3753
CONF-641105–	**(Symposium on the Use of Radioisotopes in Animal Nutrition and Physiology, Prague, Nov. 23–27, 1964)**	
1	19-8739	See HW-SA-3746
CONF-641106–	**(American Society of Metals Meeting, Richland, Wash., Nov. 16, 1964)**	
1	19-9635	See HW-SA-3754
2	19-9657	See HW-SA-3770
CONF-641107–	**(American Society for Quality Control 8th Annual Technical Conference of the Chemical Division, Gatlinburg, Tenn., Nov. 5–6, 1964)**	
1	19-9575	See HW-SA-3762
CONF-641108–	**(American Physical Society, New York, Nov. 4–8, 1964)**	
1	19-10391	See MATT-296
CONF-641109–	**(International Congress on Application of Large Radiation Sources in Industry, Amsterdam, Nov. 12–13, 1964)**	
1	19-9164	Dep.(mn)
CONF-641110–	**(Tennessee Academy of Science Meeting, Memphis, Tenn.,**	

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	Nov. 27–28, 1964)	
1	19-9242	See ORNL-P-784
2	19-9569	See ORNL-P-782
CONF-641111–	**(US–Japan Information Exchange Meeting on Ceramic Nuclear Fuels 19th High Temperature Fuels Committee Meeting, Canoga Park, Calif., Nov. 16–18, 1964)**	
2	19-9606	See LA-DC-6712
3	19-9734	See LA-DC-6713
CONF-641201–	**(American Institute of Chemical Engineers Annual Meeting, Boston, Dec. 6–10, 1964)**	
3	19-9346	ORINS
5	19-9345	ORINS
7	19-9563	ORINS
9	19-9562	ORINS
10	19-9343	ORINS
CONF-641202–	**(Annual Meeting of the American Association of Physicists in Medicine, Chicago, Ill., Dec. 4, 1964)**	
1	19-9479	See HW-SA-3773
CONF-641203–	**(Reactor Decontamination Information Exchange Group Meeting, Vallecitos, Calif., Dec. 3–4, 1964)**	
1	19-9047	See ORNL-P-718
CONF-641204–	**(Reliability Program Management Seminar, Rock Island, Ill., Nov. 30–Dec. 4, 1964)**	
1	19-10682	See SC-DC-64-2041
CONF-641206–	**(Meeting of the St. Louis Society of Analysts, St. Louis, Dec. 15, 1964)**	
1	19-9405	See LA-DC-6804
COO–		
7-333	19-10331	Phys. Rev., 137: B284-93(1965)
32-105	19-9165	Dep.(mn); $1.00(cy), 1(mn) OTS
32-106	19-9166	Dep.(mn); $2.00(cy), 1(mn) OTS
279	19-10532	Dep.; $4.00(OTS)
427-39	19-9788	J. Math. Phys. (N. Y.), 6: 106-11(1965)
623-105	19-9766	Dep.(mn); $1.00(cy), 1(mn) OTS
652-9	19-10533	Dep.(mn); $1.00(cy), 1(mn) OTS
881-41	19-10084	Phys. Rev., 137: B414-22(1965)
1073-10	19-9201	Korean J. Zool., 7: 1-5(1964)
1148-91	19-10668	Dep.(mn); $2.00(cy), 1(mn) OTS
1148-92	19-10669	Dep.(mn); $1.00(cy), 1(mn) OTS
1198-205	19-10347	Phys. Rev., 137: A961-74(1965)
1198-206	19-9142	Phys. Rev., 137: A1016-27(1965)
1198-223	19-10670	Dep.(mn); $4.00(cy), 3(mn) OTS
1198-225	19-9919	Phys. Rev., 135: A1099-110(1964)
1198-228	19-10671	Dep.(mn); $3.00(cy), 2(mn) OTS
1319-18	19-9596	Dep.(mn); $1.00(cy), 1(mn) OTS
CRR–	**(Canadian)**	
861	19-10506	Dep.(mn); $1.50(AECL)
CRRP–	**(Canadian)**	
913	19-10480	For addendum see CRRP-1185
1090	19-10480	For addendum see CRRP-1185
1185	19-10480	Dep.; $1.00(AECL)
CRT–	**(Canadian)**	
1187(Pt.A)	19-9729	Dep.; $1.50(AECL)
CVNA–	**(Misc.)**	
216	19-10534	Dep.(mn); $3.00(cy), 2(mn) OTS
217	19-10535	Dep.(mn); $2.00(cy), 1(mn) OTS
218	19-10536	Dep.(mn); $2.00(cy), 1(mn) OTS
DASA–	**(Misc.)**	
1233	19-10161	See RM61TMP-33
1499	19-9490	See SCC-406R-2
DMIC–	**(Non-AEC)**	
193	19-9597	$1.50(OTS)
DMIC-Memo–	**(Non-AEC)**	
197	19-9598	$1.00(OTS)
DMS–	**(Non-AEC)**	
64-25	19-9653	
DP–		
860(Vol.II)	19-9632	Dep.; $4.00(OTS)
899	19-10537	Dep.; $4.00(OTS)
906	19-9621	Dep.; $2.00(OTS)
920	19-9280	Dep.; $1.00(OTS)
922	19-9304	Dep.; $2.00(OTS)
923	19-9249	Dep.; $1.00(OTS)
928	19-10507	Dep.; $3.00(OTS)
931	19-9305	Dep.; $1.00(OTS)
DSR–	**(Non-AEC)**	
8734-5	19-9320	$3.00(OTS)
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EACRP-U–	**(European-American Committee on Reactor Physics)**	
18	19-10640	Dep.(mn)
ER–	**(Misc.)**	
5088	19-9310	See NASA-CR-54013
5396A	19-9311	See NASA-CR-54174
ESD-TDR–	**(Non-AEC)**	
64-134	19-9353	$5.00(OTS)
64-230	19-9354	See GDC-64-026
EUR–	**(European Atomic Energy Community)**	
1607.e	19-8785	Dep.(mn)
1645.f	19-9552	Dep.(mn)
1753.f	19-10518	See EURAEC-1005
1806.f	19-9765	See CEA-R-2448
1825.i	19-8738	Dep.(mn)
1884.e	19-8721	Dep.(mn)
2103.e	19-10481	Dep.(mn)
2104.e	19-10482	Dep.(mn)
2152.e	19-10453	Dep.(mn)
2155.e	19-9963	Dep.(mn)
2156.e	19-9058	Dep.(mn)
2166.e	19-9599	Dep.(mn)
2178.e	19-10641	Dep.(mn)
EUR-C–		
4630/64e	19-10573	See TID-21407
EUR-CEA–	**(European Atomic Energy Community)**	
FC-260	19-9360	For translation see ORNL-tr-302
EURAEC–		
703	19-10659	Dep.(mn); $5.00(cy), 3(mn) OTS
1005	19-10518	Dep.(mn); $2.60(fs), $1.10(mf) JCL
1094	19-9740	Dep.(mn); $3.00(cy), 2(mn) OTS
1102	19-9654	Dep.(mn); $2.00(cy), 1(mn) OTS
1106	19-9633	Dep.(mn); $6.00(cy), 4(mn) OTS
1164	19-10459	Dep.(mn); $1.00(cy), 1(mn) OTS
1166	19-9634	Dep.(mn); $3.00(cy), 2(mn) OTS
1186	19-10709	Dep.(mn); $1.10(fs), $0.80(mf) JCL
1194	19-10642	Dep.(mn); $2.00(cy), 1(mn) OTS
1198	19-10643	Dep.(mn); $3.00(cy), 2(mn) OTS
1209	19-9600	Dep.(mn); $1.00(cy), 1(mn) OTS
1234	19-10484	See GEAP-4730
1244	19-9326	See GEAP-4727
1256	19-10517	See WCAP-3385-1
1257	19-10500	See BAW-3125-2
1260	19-9655	Dep.(mn); $1.00(cy), 1(mn) OTS
1284	19-9656	Dep.(mn); $2.00(cy), 2(mn) OTS
1285	19-9620	See BMI-1700
1286	19-9299	See ACNP-64030
1287	19-9611	See UNC-5102
FTD-MT–	**(Non-AEC)**	
63-261	19-9348	OTS
64-64	19-10710	$6.00(OTS)
FZK–	**(Non-AEC)**	
217	19-9730	
GA–	**(Misc.)**	

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5273	19-9731	Dep.(mn); $1.00(cy), 1(mn) OTS
5600	19-10235	Nucl. Sci. Eng., 21: 268-70(1965)
5631	19-9071	Anal. Chem., 37: 129-32(1965)
GDC–	**(Non-AEC)**	
64-026	19-9354	$4.00(OTS)
GEAP–	**(Misc.)**	
329	19-10220	Dep.(mn); $3.00(cy), 2(mn) OTS
3174	19-10606	Dep.(mn); $3.00(cy), 2(mn) OTS
3194 & Add.	19-10607	Dep.(mn); $1.00(cy), 1(mn) OTS
3224	19-10608	Dep.(mn); $1.00(cy), 1(mn) OTS
3244	19-10609	$2.00(cy), 1(mn) OTS
3249	19-10610	Dep.(mn); $2.00(cy), 1(mn) OTS
3329(Rev.1)	19-10611	Dep.(mn); $1.00(cy), 1(mn) OTS
3330	19-10612	Dep.(mn); $1.00(cy), 1(mn) OTS
3339	19-10613	Dep.(mn); $2.00(cy), 1(mn) OTS
3376	19-10508	Dep.(mn); $2.00(cy), 1(mn) OTS
3376(Add.)	19-10509	Dep.(mn); $1.00(cy), 1(mn) OTS
3381(Rev.1)	19-10614	Dep.(mn); $3.00(cy), 2(mn) OTS
3445	19-10615	Dep.(mn); $1.00(cy), 1(mn) OTS
3470	19-9601	Dep.(mn); $2.00(cy), 1(mn) OTS
4425	19-10538	Dep.(mn); $3.00(cy), 2(mn) OTS
4573	19-10539	Dep.(mn); $4.00(cy), 2(mn) OTS
4594	19-10540	Dep.(mn); $3.00(cy), 2(mn) OTS
4596	19-9732	Dep.(mn); $2.00(cy), 1(mn) OTS
4630	19-10483	Dep.(mn); $4.00(cy), 2(mn) OTS
4703	19-10541	Dep.(mn); $4.00(cy), 2(mn) OTS
4716	19-10510	Dep.(mn); $2.00(cy), 1(mn) OTS
4727	19-9326	Dep.(mn); $2.00(cy), 1(mn) OTS
4730	19-10484	Dep.(mn); $2.00(cy), 1(mn) OTS
4749	19-9327	Dep.(mn); $2.00(cy), 1(mn) OTS
GEMP–	**(Misc.)**	
85	19-10467	Dep.; $1.00(cy), 1(mn) OTS
GNE/Phys–	**(Non-AEC)**	
64-1	19-9733	$3.00(OTS)
64-2	19-9167	$3.00(OTS)
64-7	19-10221	$4.00(OTS)
64-10	19-10542	$4.00(OTS)
64-14	19-10616	$4.00(OTS)
HASL–		
153	19-9755	$3.00(OTS)
155	19-9365	Dep.; $4.00(OTS)
HI–	**(Non-AEC)**	
361-RR/2	19-9355	$3.00(OTS)
HW–		
51934	19-9404	Dep.(mn); $2.00(cy), 1(mn) OTS
61657	19-10644	$1.00(cy), 1(mn) OTS
65323	19-9250	$1.00(cy), 1(mn) OTS
66829	19-9441	$1.00(cy), 1(mn) OTS
72432	19-10543	Dep.(mn); $3.00(cy), 2(mn) OTS
72740	19-10485	$1.00(cy), 1(mn) OTS
74539	19-10511	Dep.; $3.00(OTS)
77027	19-10544	Dep.(mn); $3.00(cy), 2(mn) OTS
78428	19-10545	Dep.(mn); $1.00(cy), 1(mn) OTS
81172	19-10602	Dep.(mn); $1.00(cy), 1(mn) OTS
81397	19-10645	Dep.(mn); $1.00(cy), 1(mn) OTS
81413	19-10603	Dep.; $1.00(OTS)
81601	19-9602	Dep.; $4.00(cy), 2(mn) OTS
83218	19-10660	Dep.(mn); $2.00(cy), 1(mn) OTS
83336	19-10646	$1.00(cy), 1(mn) OTS
83337	19-10647	$1.00(cy), 1(mn) OTS
83431	19-10514	Dep.(mn); $3.00(cy), 2(mn) OTS
83461	19-10661	Dep.; $3.00(OTS)
83611	19-9045	Dep.; $1.00(OTS)
83868	19-9478	Dep.; $1.00(OTS)
83967	19-9442	Dep.(mn); $2.00(cy), 1(mn) OTS
84084	19-9306	Dep.(mn); $1.00(cy), 1(mn) OTS
84251	19-9059	Dep.(mn); $1.00(cy), 1(mn) OTS
HW-SA–		
3316	19-9366	Dep.(mn); $1.00(cy), 1(mn) OTS
3400	19-9347	Dep.(mn); $1.00(cy), 1(mn) OTS
3552	19-9691	J. Am. Ceram. Soc., 47: 650(1964)
3683	19-10546	Dep.(mn); $1.00(cy), 1(mn) OTS
3746	19-8739	Dep.(mn); $1.00(cy), 1(mn) OTS
3753	19-9361	Dep.(mn); $1.00(cy), 1(mn) OTS
3754	19-9635	Dep.(mn); $1.00(cy), 1(mn) OTS
3762	19-9575	Dep.(mn); $1.00(cy), 1(mn) OTS
3770	19-9657	Dep.(mn); $1.00(cy), 1(mn) OTS
3772	19-10515	$2.00(cy), 1(mn) OTS
3773	19-9479	$1.00(cy), 1(mn) OTS
IAE–	**(Russian)**	
665	19-10400	For translation see UCRL-Trans-1133(L)
667	19-10401	For translation see UCRL-Trans-1134(L)
IAEA-R–	**(International Atomic Energy Agency)**	
1	19-9367	Dep.(mn)
37-5	19-8740	Dep.(mn)
IDO–		
14649	19-9060	Dep.; $2.00(OTS)
16981	19-10648	Dep.(mn); $7.06(cy), 6(mn) OTS
17032	19-9307	Dep.(mn); $3.00(cy), 1(mn) OTS
24467	19-10649	Dep.; $6.00(OTS)
IEA–	**(Brazilian)**	
73	19-8778	p.259-68 of "Use of Radioisotopes in Animal Biology and the Medical Sciences. Vol. I." New York, Academic Press, 1962
IFA-EC–	**(Rumanian)**	
7	19-9576	Dep.(mn)
IFA-HE–	**(Rumanian)**	
54	19-10014	Dep.(mn)
IMP-AEC–		
32	19-9949	J. Chem. Phys., 42: 537-9(1965)
IPP–	**(German)**	
1/30	19-10387	Dep.(mn)
2/33	19-10388	Dep.(mn)
3/14	19-9443	Dep.(mn)
3/19	19-9964	Dep.(mn)
4/8	19-9308	Dep.(mn)
6/6	19-9577	Dep.(mn)
6/16	19-10389	Dep.(mn)
6/27	19-10390	Dep.(mn)
IRD–	**(British)**	
63-82	19-9328	$6.60(OTS)
IS–		
450	19-9156	Dep.(mn); $9.93(cy), 11(mn) OTS
824	19-9677	Acta Cryst., 18: 60-2(1965)
900	19-10672	Dep.; $7.76(cy), 7(mn) OTS
910	19-10055	Nuovo Cimento (10): 35: 150-9(1965)
912	19-10279	Nucl. Phys., 63: 581-7(1965)
967	19-10673	Dep.; $3.00(OTS)
970	19-9069	Anal. Chem., 37: 67-70(1965)
994	19-9658	Dep.; $4.00(OTS)
ISS–	**(Italian)**	
64/32	19-8722	Dep.(mn)
JINR–	**(Russian)**	
E-1851	19-9168	Dep.(mn)
P-1808	19-10015	Dep.(mn)
P-1823	19-10016	Dep.(mn)
P-1824	19-10242	Dep.(mn)
P-1837	19-10243	Dep.(mn)
P-1857	19-10244	Dep.(mn)
P-1863	19-10245	Dep.(mn)
P-1868	19-9884	Dep.(mn)
P-1872	19-9578	Dep.(mn)
P-1881	19-10246	Dep.(mn)
P-1882	19-10247	Dep.(mn)
P-1899	19-9480	Dep.(mn)
P-1904	19-9095	Dep.(mn)
P-1909	19-9481	Dep.(mn)
JPRS–	**(Non-AEC)**	

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26888	19-8743	$1.00(OTS)
27220	19-8956	$1.00(OTS)
27289	19-8797	$1.00(OTS)
27293	19-8798	$1.00(OTS)
27343	19-8799	$1.00(OTS)
27372	19-9777	OTS
27593	19-9671	$3.00(OTS)
K–		
1614	19-9579	Dep.; $5.00(OTS)
1623	19-10674	Dep.; $3.00(OTS)
KFK–	**(German)**	
247	19-9444	Dep.(mn)
KFKI–	**(Hungarian)**	
23/1963	19-10248	Dep.(mn)
KN–	**(Non-AEC)**	
674-63-7(R)	19-9885	$9.60(OTS)
LA–		
3106(Vol.II)	19-9580	Dep.; $7.24(cy), 13(mn) OTS
3130	19-9445	Dep.; $7.00(OTS)
3148-MS	19-10486	Dep.; $3.00(OTS)
3160	19-9061	Dep.; $1.00(OTS)
3166-MS	19-10487	Dep.; $2.00(OTS)
3173-MS	19-9605	Dep.; $1.00(OTS)
3177-MS	19-9329	Dep.; $1.00(OTS)
3190-MS	19-10651	Dep.; $2.00(cy), 1(mn) OTS
LA-DC–		
6345	19-9793	Phys. Rev., 135: A1272-7(1964)
6519	19-9114	Inorg. Chem., 4: 65-70(1965)
6564	19-9458	Rev. Sci. Instr., 36: 143-5(1965)
6594	19-9659	Dep.(mn); $1.00(cy), 1(mn) OTS
6712	19-9606	Dep.(mn); $1.00(cy), 1(mn) OTS
6713	19-9734	Dep.(mn); $1.00(cy), 1(mn) OTS
6804	19-9405	Dep.(mn); $1.00(cy), 1(mn) OTS
LA-tr–		
64-32	19-9614	Dep.(mn); $1.10(fs), $0.80(mf) JCL
LADC–		
6270	19-9900	Acta Cryst., 18: 104-9(1965)
LAMS–		
3079	19-9768	Dep.(mn); $2.00(cy), 1(mn) OTS
3083	19-9282	Dep.; $6.00(OTS)
LF–		
18	19-9062	Dep.; $0.50(OTS)
19	19-8723	Dep.; $0.75(OTS)
LGI–	**(Italian)**	
63/23	19-9283	Dep.(mn)
LNF–	**(Italian)**	
64/35	19-10203	Phys. Rev., 137: A796-800(1965)
MATT–		
296	19-10391	Dep.(mn); $1.00(cy), 1(mn) OTS
MATT-Q–		
21	19-10392	Dep.; $5.00(OTS)
MHD–	**(Non-AEC)**	
660	19-9965	$3.00(OTS)
MIT–	**(Misc.)**	
2098-47	19-10190	Ann. Phys. (N. Y.), 30: 203-34(1964)
2098-66	19-9925	Phys. Rev., 137: A975-8(1965)
MITS–		
52	19-9362	Dep.(mn); $1.00(cy), 1(mn) OTS
ML-TDR–	**(Non-AEC)**	
64-70	19-9607	$6.00(OTS)
64-81	19-9608	$5.00(OTS)
64-83	19-9609	$5.00(OTS)
64-166	19-9660	$4.00(OTS)
64-295	19-9636	See NMI-9700-24
N–	**(Misc.)**	
64-33100	19-9966	See NASA-CR-54194
64-34000	19-9661	See NASA-CR-54203
65-11023	19-9622	See NASA-CR-54200
65-11041	19-10623	See PWA-2351(Vol.1)
65-12016	19-9662	See NASA-CR-54228
65-13095	19-9311	See NASA-CR-54174
NAA-SR–		
8119	19-10468	Dep.; $2.00(OTS)
9213(Vol.I)	19-10548	Dep.(mn); $7.00(cy), 5(mn) OTS
9999	19-10675	Dep.; $7.00(cy), 5(mn) OTS
NAA-SR-Memo–		
6918	19-9309	Dep.(mn); $1.00(cy), 1(mn) OTS
7429	19-10549	Dep.(mn); $1.00(cy), 1(mn) OTS
10286	19-10617	Dep.(mn); $3.00(cy), 2(mn) OTS
10399	19-10618	$2.00(cy), 1(mn) OTS
10421	19-10619	Dep.(mn); $3.00(cy), 3(mn) OTS
10464	19-10620	$2.00(cy), 1(mn) OTS
10480	19-10621	Dep.(mn); $2.00(cy), 1(mn) OTS
10494	19-10622	Dep.(mn); $1.00(cy), 1(mn) OTS
10512	19-10460	Dep.(mn); $1.00(cy), 1(mn) OTS
10593	19-10550	Dep.(mn); $1.00(cy), 1(mn) OTS
NAS-NRC–	**(Non-AEC)**	
PUB-1133	19-9886	$7.00(NAS)
NASA-CR–	**(Misc.)**	
54013	19-9310	
54172	19-10623	See PWA-2351(Vol.1)
54174	19-9311	
54194	19-9966	$3.00(OTS)
54200	19-9622	$2.00(cy), 1(mn) OTS
54203	19-9661	$1.00(OTS)
54204	19-10469	
54228	19-9662	$0.50(OTS)
NASA-SP–	**(Misc.)**	
7011(02)	19-8786	
NASA-TN–	**(Misc.)**	
D-2218	19-10160	$1.00(OTS)
D-2536	19-10393	$3.00(OTS)
D-2549	19-9482	$2.00(OTS)
D-2568	19-9663	$1.00(OTS)
D-2571	19-10394	$1.00(OTS)
NLCO–		
933	19-8724	Dep.(mn); $1.00(cy), 1(mn) OTS
NMI–	**(Misc.)**	
9700-24	19-9636	
NMI-TJ–	**(Misc.)**	
13	19-9637	
NP–	**(AEC File No. for Non-AEC Reports)**	
14359	19-9568	Dep.(mn)
14418	19-9806	Dep.(mn)
14419	19-9483	Dep.(mn)
14448	19-8725	$4.00(OTS)
14459	19-9368	Dep.(mn)
14472	19-10017	Dep.(mn)
14473	19-9484	Dep.(mn)
14477	19-10249	Dep.(mn)
14487	19-10018	Dep.(mn)
14488	19-9485	Dep.(mn)
14494	19-9312	
14495	19-9486	Dep.(mn)
14496	19-10250	Dep.(mn)
14497	19-10019	Dep.(mn)
14498	19-10251	Dep.(mn)
14502	19-9369	Dep.(mn)
14531	19-9385	
14551	19-10676	Dep.(mn)
14552	19-10677	Dep.(mn)

Report No.	Abstract No.	Availability
14556	19-8726	
14583	19-10252	Dep.(mn)
14604	19-9446	
14605	19-9330	
14610	19-9447	
14615	19-10678	Dep.(mn)
14618	19-9371	Dep.(mn)
14626	19-10253	Dep.(mn)
14632	19-9623	
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
1190	19-8996	Dep.(mn); $1.10(fs), $0.80(mf) JCL
1197	19-8997	Dep.(mn); $1.10(fs), $0.80(mf) JCL
1198	19-9049	Dep.(mn); $3.60(fs), $1.25(mf) JCL
1199	19-9066	Dep.(mn); Free(J. T. Baker Chemical Co., Phillipsburg, N. J.)
1204	19-8800	Dep.(mn); $1.60(fs), $0.80(mf) JCL
NRL–	**(Misc.)**	
F14	19-9371	See NP-14618
NRL-Memo–	**(Misc.)**	
1424	19-9735	$3.60(OTS)
NSL–	**(Non-AEC)**	
62-105-5	19-10395	$3.00(OTS)
NYO–		
1480-5	19-9581	Dep.(mn); $2.00(cy), 1(mn) OTS
2150-3	19-9769	Dep.(mn); $3.00(cy), 2(mn) OTS
2391-6	19-9770	Dep.(mn); $2.00(cy), 1(mn) OTS
2471-5	19-10679	Dep.(mn); $4.00(cy), 2(mn) OTS
2471-6	19-10680	Dep.(mn); $3.00(cy), 1(mn) OTS
2567-1	19-9157	Dep.(mn); $1.00(cy), 1(mn) OTS
2881-1	19-8793	Dep.(mn); $2.00(cy), 1(mn) OTS
2915-1	19-9169	Dep.(mn); $1.00(cy), 1(mn) OTS
3018-7	19-10681	Dep.(mn); $3.00(cy), 2(mn) OTS
3316-1	19-10551	Dep.; $3.50(OTS)
3421-2	19-9448	Dep.(mn); $1.00(cy), 1(mn) OTS
10332	19-9362	See MITS-52
OCD–	**(Non-AEC)**	
2131-F	19-9487	$2.00(OTS)
ORNL–		
3664	19-9284	Dep.; $1.00(OTS)
3672	19-10254	Dep.; $3.00(OTS)
3686	19-10552	Dep.; $6.00(OTS)
3708	19-10553	Dep.; $7.04(cy), 9(mn) OTS
3725	19-9251	Dep.; $2.00(OTS)
3728	19-9664	Dep.; $3.00(OTS)
3732	19-9252	Dep.; $2.00(OTS)
3744	19-9063	Dep.; $3.00(OTS)
3747	19-10470	Dep.; $1.00(OTS)
ORNL-P–	**(Misc.)**	
114	19-10233	Nucl. Sci. Eng. 21: 262-5(1965)
183	19-10302	Nucl. Sci. Eng., 21: 257-8(1965)
258	19-10280	Nucl. Phys., 63: 588-92(1965)
369	19-9890	See NAS-NRC-PUB-1133(p.49-67)
385	19-9889	See NAS-NRC-PUB-1133(p.39-47)
386	19-9892	See NAS-NRC-PUB-1133(p.99-101)
403	19-9096	Dep.(mn); $1.00(cy), 1(mn) OTS
412	19-10346	Phys. Rev., 137: A895-906(1965)
457	19-9210	Phys. Rev., 137: A942-8(1965)
489	19-9908	J. Chem. Phys., 42: 713-19(1965)
520	19-10428	Phys. Rev. Letters, 13: 703-5(1964)
674	19-10324	Phys. Letters, 14: 51-3(1965)
707	19-9097	Dep.(mn); $3.00(cy), 1(mn) OTS
718	19-9047	Dep.(mn); $2.00(cy), 1(mn) OTS
782	19-9569	Dep.(mn); $1.00(cy), 1(mn) OTS
784	19-9242	Dep.(mn); $1.00(cy), 1(mn) OTS
818	19-9359	Dep.(mn); $1.00(cy), 1(mn) OTS
ORNL-TM–		
940	19-8794	Dep.(mn; $2.00(cy), 1(mn) OTS
971	19-10255	Dep.(mn); $2.00(cy), 1(mn) OTS
993	19-10488	Dep.(mn); $3.00(cy), 2(mn) OTS
ORNL-tr–		

Report No.	Abstract No.	Availability
302	19-9360	Dep.(mn); $2.60(fs), $0.95(mf) JCL
385	19-9672	Dep.(mn); $1.60(fs), $0.80(mf) JCL
OTS–	**(Misc.)**	
64-11409/2	19-8732	Polish Medical Journal, Volume III, Number 2, 1964. Translation of Patol. Polska, 14: 235-488(1963). $2.50(OTS)
P–	**(Misc.)**	
157(RAND)	19-10454	$2.00(OTS)
PATENTS	**(British)**	**3s. 6d. each, U. K. Patent Office**
972,466	19-10526	
972,474	19-10475	
972,798	19-10476	
972,901	19-10601	
973,448	19-9435	
973,529	19-10458	
973,708	19-9467	
973,709	19-9468	
PATENTS	**(French)**	
918,872	19-9614	For translation see LA-tr-64-32
PATENTS	**(German)**	
1,174,040	19-9358	
1,174,915	19-9541	
1,175,803	19-10477	
PATENTS	**(U. S.)**	
3,076,894	19-9469	
3,164,019	19-9470	
3,164,462	19-9618	
3,164,718	19-9471	
3,164,897	19-10714	
3,165,922	19-10715	
3,166,133	19-10716	
3,166,136	19-10717	
3,167,070	19-10718	
3,167,482	19-10527	
3,167,654	19-9542	
3,167,655	19-10376	
PATENTS	**(U.S.S.R.)**	
162,896	19-9543	
164,252	19-9278	
PG-Report–	**(British)**	
605	19-10662	Dep.(mn); $2.00(BIS); 10s. (HMSO)
PPAD–		
507-E	19-9449	Dep.(mn); $1.00(cy), 1(mn) OTS
529-E	19-9488	Dep.(mn); $1.00(cy), 1(mn) OTS
PR-P–	**(Canadian)**	
63	19-9771	Dep.; $1.50(AECL)
PWA–	**(Non-AEC)**	
2320(Vol.1)	19-9331	
2351(Vol.1)	19-10623	$6.00(OTS)
PWAC–	**(Misc.)**	
430	19-9332	Dep.; $5.00(OTS)
R–	**(Misc.)**	
349	19-10451	See AD-609049
64SD-70	19-10396	$2.00(OTS)
RADC-TDR–	**(Misc.)**	
64-174	19-10397	$3.00(OTS)
REIC–	**(Misc.)**	
36	19-9546	Dep.(mn); $6.00(cy), 5(mn) OTS
REIC-Access–	**(Misc.)**	
82	19-9736	Dep.(mn); $2.00(cy), 1(mn) OTS
RFP–		
418	19-9406	Dep.; $2.00(OTS)
478	19-9638	Dep.; $1.00(OTS)

Report No.	Abstract No.	Availability
RISO–	**(Danish)**	
92	19-10256	Dep.(mn)
RLE-TR–	**(Non-AEC)**	
427	19-10189	
RM–	**(Misc.)**	
61TMP-33	19-10161	$6.00(OTS)
RME–		
4551	19-9389	Dep.; $2.00(OTS)
RT-EL–	**(Italian)**	
(64)-11	19-9489	Dep.(mn)
RT-FI–	**(Italian)**	
(64)-9	19-9772	Dep.(mn)
(64)-19	19-10489	Dep.(mn)
RT-ING–	**(Italian)**	
(64)-8	19-9333	Dep.(mn)
(64)-9	19-9313	Dep.(mn)
RTD-TDR–	**(Non-AEC)**	
63-3116	19-9285	$6.00(OTS)
SAM-TDR–	**(Non-AEC)**	
64-14	19-9407	$1.00(OTS)
64-29	19-8795	$0.50(OTS)
SB–	**(Non-AEC)**	
63-71	19-9944	See AD-443485
SC-DC–		
64-380	19-9048	Dep.(mn); $1.00(cy), 1(mn) OTS
64-2041	19-10682	Dep.(mn); $2.00(cy), 1(mn) OTS
SC-R–		
64-1369	19-10684	Dep.(mn); $1.00(cy), 1(mn) OTS
SC-T–		
64-2011	19-9673	Dep.(mn); $4.60(fs), $1.43(mf) JCL
65-704	19-9778	Dep.(mn); $3.60(fs), $1.24(mf) JCL
SC-TM–		
64-58	19-10685	Dep.(mn); $1.00(cy), 1(mn) OTS
64-541	19-10686	Dep.(mn); $3.00(cy), 2(mn) OTS
64-996	19-10687	Dep.(mn); $2.00(cy), 1(mn) OTS
64-1668	19-10688	Dep.(mn); $1.00(cy), 1(mn) OTS
SCL-DC–		
64-9	19-10689	Dep.(mn); $1.00(cy), 1(mn) OTS
SCL-DR–		
64-105	19-10690	Dep.(mn); $1.00(cy), 1(mn) OTS
64-113	19-10691	Dep.(mn); $2.00(cy), 1(mn) OTS
64-116	19-10683	Dep.(mn); $2.00(cy), 1(mn) OTS
64-144	19-10692	Dep.(mn); $2.00(cy), 1(mn) OTS
SCNC–	**(Misc.)**	
270	19-9624	Dep.(mn); $2.00(cy), 1(mn) OTS
SEL–	**(Misc.)**	
63-110	19-10162	$4.00(OTS)
SGC–	**(Non-AEC)**	
406R-2	19-9490	$3.00(OTS)
SLAC-PUB–		
42	19-10088	Phys. Rev., 137: B449-51(1965)
SR–	**(Misc.)**	
110	19-9353	See ESD-TDR-64-134
SRO–		
109	19-10693	Dep.(mn); $3.00(cy), 1(mn) OTS
111	19-10571	Dep.(mn); $1.00(cy), 1(mn) OTS
STI-DOC–	**(International Atomic Energy Agency)**	
10/31	19-9427	Training in Radiological Protection, Curricula and Programming. Technical Reports Series No. 31. 1964. $2.50; Sch 52.50; 15s.stg; F.fr.10,-; DM 8,- (IAEA)
TAB-R–		
4	19-8784	See CONF-813-1
TDVI–	**(Canadian)**	
33	19-10461	$1.00(AECL)
TID–		
3043(Rev.2) (Suppl.2)	19-10694	Dep.; $4.00(OTS)
4100(Suppl.25)	19-9807	Dep.; Free(DTI Extension)
4101(Rev.1)	19-9286	Dep.
8200(11th Rev.)	19-10462	Dep.; $1.00(OTS)
19775	19-9130	J. Phys. Chem., 68: 2941-6(1964)
20274	19-10695	Dep.(mn); $3.00(cy), 2(mn) OTS
20342	19-10696	Dep.(mn); $3.00(cy), 1(mn) OTS
20343	19-10697	Dep.(mn); $1.00(cy), 1(mn) OTS
20372	19-10698	Dep.(mn); $1.00(cy), 1(mn) OTS
20373	19-8727	Dep.(mn); $1.00(cy), 1(mn) OTS
20374	19-10699	Dep.(mn); $1.00(cy), 1(mn) OTS
20545	19-9919	Phys. Rev., 135: A1099-110(1964)
20874	19-10278	Nucl. Phys., 63: 575-80(1965)
20922	19-10332	Phys. Rev., 137: B301-4(1965)
20930	19-10144	Phys. Rev., 137: B452-4(1965)
20991	19-10277	Nucl. Phys., 63: 561-74(1965)
21049	19-9073	Anal. Chem., 37: 169-70(1965)
21189	19-10398	Dep.; $6.00(cy), 4(mn) OTS
21232	19-9170	Dep.(mn); $2.00(cy), 1(mn) OTS
21282	19-9808	Dep.(mn); $8.06(cy), 11(mn) OTS
21328	19-10700	Dep.(mn); $1.00(cy), 1(mn) OTS
21335	19-9773	Dep.(mn); $5.00(cy), 3(mn) OTS
21390	19-9582	Dep.(mn); $6.00(cy), 5(mn) OTS
21406	19-10572	Dep.(mn); $2.00(cy), 1(mn) OTS
21407	19-10573	Dep.(mn); $2.00(cy), 2(mn) OTS
21432	19-9363	Dep.(mn); $3.00(cy), 2(mn) OTS
TO-B–	**(Non-AEC)**	
64-10	19-9756	$2.25(OTS)
TR–	**(Misc.)**	
1237	19-10379	See AD-603901
TT–	**(Canadian)**	
64-51145	19-8743	See JPRS-26888
64-51475	19-8956	See JPRS-27220
64-51545	19-8797	See JPRS-27289
64-51549	19-8798	See JPRS-27293
64-51599	19-8799	See JPRS-27343
64-51628	19-9777	See JPRS-27372
64-51821	19-9671	See JPRS-27593
UCRL–		
6999(Rev.II)	19-9293	Dep.(mn); $2.00(cy), 1(mn) OTS
7617-T	19-10701	Dep.(mn); $2.00(cy), 1(mn) OTS
7631-T	19-9098	Dep.(mn); $1.00(cy), 1(mn) OTS
7652-T	19-10702	Dep.(mn); $1.00(cy), 1(mn) OTS
7666	19-10259	Dep.(mn); $1.00(cy), 1(mn) OTS
7670	19-10260	Dep.(mn); $1.00(cy), 1(mn) OTS
7676(Rev.I)	19-10338	Phys. Rev., 137: B347-51(1965)
7680	19-10703	Dep.(mn); $1.00(cy), 1(mn) OTS
7681	19-10704	Dep.(mn); $1.00(cy), 1(mn) OTS
7686	19-10490	Dep.(mn); $1.00(cy), 1(mn) OTS
7734	19-9897	Dep.; $1.00(OTS)
7784	19-9774	Dep.; $2.00(OTS)
7822	19-10705	Dep.(mn); $1.00(cy), 1(mn) OTS
7868	19-9789	J. Opt. Soc. Am., 54: 1168(1964)
7920(Rev.I)	19-9583	Dep.; $3.00(OTS)
7936	19-9678	Acta Cryst., 18: 131-2(1965)
7971	19-10335	Phys. Rev., 137: B326-31(1965)
10426(Rev.1)	19-10200	Phys. Rev., 137: A748-59(1965)
10980(Rev.)	19-9492	Dep.(mn); $3.00(cy), 2(mn) OTS
11067	19-9665	Dep.(mn); $3.00(cy), 2(mn) OTS
11328(Rev.1)	19-10020	Dep.; $2.00(OTS)
11349(Rev.)	19-10336	Phys. Rev., 137: B332-45(1965)
11466	19-9775	Dep.; $3.00(cy), 2(mn) OTS
11517	19-9493	Dep.(mn); $1.00(cy), 1(mn) OTS

Report No.	Abstract No.	Availability
11559	19-10298	Nucl. Phys., 64: 161-8(1965)
11590	19-10086	Phys. Rev., 137: B438-43(1965)
11603	19-10334	Phys. Rev., 137: B315-25(1965)
11687	19-9666	Dep.(mn); $3.00(cy), 1(mn) OTS
11690	19-10021	Dep.(mn); $3.00(cy), 2(mn) OTS
11704	19-9099	Dep.(mn); $4.00(cy), 2(mn) OTS
11738	19-9494	Dep.(mn); $1.00(cy), 1(mn) OTS
11740	19-10297	Nucl. Phys., 64: 147-60(1965)
11763	19-10706	Dep.(mn); $7.60(fs), $2.42(mf) OTS
11771	19-9217	Science, 147: 149-50(1965)
11786	19-10707	Dep.(mn); $2.00(cy), 1(mn) OTS
12037	19-10080	Phys. Rev., 137: B294-300(1965)
12064	19-10516	Dep.; $2.00(OTS)
12128	19-10222	Dep.; $2.00(OTS)
12150	19-9495	Dep.; $2.00(OTS)
12170	19-9776	Dep.; $1.00(OTS)
12180	19-9294	Dep.(mn); $2.00(cy), 1(mn) OTS
12185	19-10708	Dep.(mn); $1.00(cy), 1(mn) OTS
12218(Pt.I)	19-9450	Dep.; $2.00(OTS)
12248	19-9295	Dep.; $1.00(OTS)
13134	19-9451	Dep.(mn); $2.00(cy), 2(mn) OTS
UCRL-Trans–		
1106(L)	19-9386	Dep.(mn); $1.00(cy), 1(mn) OTS; $1.10(fs), $0.80(mf) JCL
1108(L)	19-9296	Dep.(mn); $1.00(cy), 1(mn) OTS; $1.10(fs), $0.80(mf) JCL
1133(L)	19-10400	Dep.(mn); $3.00(cy), 1(mn) OTS; $5.60(fs), $1.76(mf) JCL
1134(L)	19-10401	Dep.(mn); $3.00(cy), 2(mn) OTS; $6.60(fs), $2.15(mf) JCL
1169(L)	19-9453	Dep.(mn); $1.00(cy), 1(mn) OTS; $1.60(fs), $0.80(mf) JCL
UJV–	**(Czechoslovakian)**	
960/64	19-9610	Dep.(mn)
1115/64	19-9253	Dep.(mn)
1136/64	19-9496	Dep.(mn)
1145/64	19-9737	Dep.(mn)
UNC–	**(Misc.)**	
5102	19-9611	Dep.(mn); $2.00(cy), 1(mn) OTS
UR–		
875-51	19-10139	Nuovo Cimento (10), 35: 324-8(1965)
URS–	**(Non-AEC)**	
639-4	19-9287	
USAELRDL-TR–	**(Non-AEC)**	
2456	19-9452	
USBM-RC–		
1119	19-9667	Dep.(mn); $1.00(cy), 1(mn) OTS
USNRDL-TR–	**(Misc.)**	
783	19-8796	
VDDIT–	**(Swedish)**	
16(4.3)	19-9738	Dep.(mn)
16(4.4)	19-9739	Dep.(mn)
VESIAC–	**(Non-AEC)**	
2131-VU	19-9385	See NP-14531
WAPD-T–		
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